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AT
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FINAL RCRA TECHNICAL ASSESSMENT REPORT OF THE COLLIS, INC. FACILITY CLINTON, IOWA EPA I.D. NO. IAD047303771

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0.0 EXECUTIVE SUMMARY

0.1 Purpose and Scope

The following sections summarize the findings and observations of a comprehensive groundwater monitoring evaluation (CME) performed at the Collis, Inc., Clinton, Iowa facility. The purpose of conducting a CME is to develop a complete understanding of a facility's topography, geology, hydrology, waste management practices, and groundwater monitoring system. Results of the CME are used to characterize the owner/operator's knowledge and to develop additional knowledge where possible, in order to support U.S. EPA Region VII enforcement and permitting requirements.

Each CME consists of two components, a technical assessment (TA) and a quality assurance quality control audit (QA/QC audit). The TA evaluates the adequacy of the information on which the design of the facility's groundwater monitoring network is based in addition to evaluating the actual design, construction and installation of the facility's groundwater monitoring system. The QA/QC audit evaluates the adequacy of the owner/operator's maintenance and operation of the groundwater monitoring network. The primary function of the QA/QC audit is to ensure that the facility's groundwater sample collection and analytical procedures are in accordance with accepted methodologies and that the data generated and reported are valid and representative of groundwater quality beneath the site. The QA/QC audit consists of obtaining groundwater samples, performing field audit measurements, evaluating sampling and measurement procedures, making field observations, and reviewing documents during an actual sampling event performed by the regulated facility. Since sample collection and handling procedures are critical for generating data that is valid and representative of in-situ groundwater, method consistency, equipment, and procedures are essential elements of the inspection that are closely evaluated.

The CME addresses compliance with general regulatory requirements for groundwater monitoring (both detection and assessment monitoring) at interim status facilities under RCRA as delineated in Subpart F 40 CFR Part 264 and 265.

0.2 Summary of Significant Findings

The following conclusions and findings are based on Jacobs' interpretation of existing data, observations, and findings from a split sampling event at the site, the requirements of 40 CFR Part 265 Subpart F, and the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD, 1986).

0.2.1 Technical Assessment

- Collis, Inc. has not adequately characterized the uppermost aquifer underlying the RCRA regulated units. Therefore, the impact from the regulated units on the uppermost aquifer cannot be evaluated (40 CFR 265.90 (a)).

- Collis, Inc. has not fully evaluated the vertical and horizontal components of groundwater flow paths beneath the site. The RCRA groundwater monitoring system must "enable sample collection from depths where appropriate aquifer flow zones exist" (40 CFR 265.91 (c)).

- Collis, Inc. has not located an upgradient groundwater monitoring well that is capable of yielding sufficient groundwater samples that are representative of background groundwater quality (40 CFR 265.91(a)(1)).

- The downgradient monitoring well network is not constructed in a manner that would allow the immediate detection of a statistically significant increase in the concentrations of hazardous waste constituents in the uppermost aquifer (40 CFR 265.91 (a)(2)).

- Collis, Inc. does not have a sufficient number of wells to adequately monitor: 1) the lower portions of the saturated alluvium and 2) the uppermost aquifer. Therefore, the concentrations of hazardous waste constituents in groundwater cannot be determined as required by 40 CFR 265.93 (d)(4)(ii).

- A groundwater quality assessment plan has not been submitted to U.S. EPA Region VII for review, thus statistical procedures for data analysis could not be evaluted (40 CFR Part 265, Subpart F, Sections 265.92(c)(2); 265.93(a), (b), (e), and (f); and 265.94(a)).

Screen lengths of existing wells vary from 5 to 10 feet. Collis, Inc. should evaluate whether the length of the screens would allow for sampling of discrete portions of the formation without resulting in dilution of contaminated groundwater in one horizon by uncontaminated groundwater in another horizon.

0.1.2 QA/QC Audit

- Collis, Inc. did not consistently follow sample collection and preservation procedures set forth in the facility's approved Sampling and Analysis Plan (40 CFR 265.92).

- Groundwater monitoring wells were not constructed to yield sufficient volumes of water for sampling (40 CFR 265.91(a)).

- Appendix III constituents were not included among the analytical parameters to characterize drinking water suitability (40 CFR 265.92(b)(1)).

- Quadruplicate samples for RCRA indicator paraemters TOC and TOX were not collected in an appropriate manner from the background well during the August 1988 sampling event (265.92(b)(3)).

- Existing wells should be evaluated regarding their performance; split samples obtained during the QA/QC audit were found to be highly turbid.

In general, background data (which provides the basis for the statistical evaluation of groundwater monitoring data) were jeopardized by improper sample measurement (pH and specific conductance), handling (TOX), and preservation procedures (TOC). Therefore, results for these parameters reported for the March and August 1988 sampling events should not be included in the background data set that will be subject to statistical evaluation. Instead, additional data collection efforts (collected under EPA oversight) should be initiated for these parameters to complete the initial background data collection activities such that the facility may proceed with the statistical evaluation of whether or not a release has occurred.

FINAL RCRA TECHNICAL ASSESSMENT REPORT OF THE COLLIS, INC. FACILITY CLINTON, IOWA

1.0 INTRODUCTION

At the request of the U.S. Environmental Protection Agency (EPA) Region VII, Jacobs Engineering Group, Inc. (Jacobs) was tasked to conduct a RCRA Comprehensive Groundwater Monitoring Evaluation under Technical Enforcement Support Contract Number 68-01-7351 (TES IV) Work Assignment No. R07006 for the Collis, Inc. facility (EPA I.D. No. IAD047303771) in Clinton, Iowa. A CME consists of two major components: a Technical Assessment (TA) and a Groundwater Sampling and Analysis Inspection. The Groundwater Sampling and Analysis Inspection for the Collis, Inc. facility was performed by Jacobs on August 10 and 11, 1988. Results of the inspection are documented in the "Final Report of RCRA Groundwater Sampling Inspection at the Collis, Inc. Facility" dated December 7, 1988 (see Attachment 9). The TA provides a means by which EPA evaluates the facility owner/operator's characterization of the site hydrogeology, placement of detection monitoring wells, monitoring well design and construction, past analytical performance, and the assessment monitoring program.

The RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD) (EPA 1986) and 40 CFR, Part 265, Subpart F were used as the compliance criteria by which the following documents were evaluated:

- "Hydrogeological Assessment for Collis Division Facility and U.S. EPA Region VII Clinton, Iowa Plant", prepared by Terracon Consultants, Inc. (Terracon) and dated September 1983.
- "Hydrogeological Assessment for Collis, Inc. and USEPA Region VII, Phase I, Part 2, Clinton, Iowa Plant," prepared by Terracon and dated July 1984.
- "Groundwater Monitoring Plan for Site Closure, Metal Finishing Impoundments, Collis, Inc., Clinton, Iowa", prepared by Warzyn Engineering, Inc. (Warzyn) and dated November 1987.

- "Status Report - Surface Impoundment Closure, Clinton, Iowa", prepared by Warzyn and dated July 1988.
- "Draft Sampling and Analysis Plan, Collis, Inc.", prepared by Warzyn and dated January 1988.

An evaluation worksheet reproduced from the TEGD and completed for the Collis, Inc. facility is included as Attachment 1. All available borehole data were used to complete the first section of the worksheet entitled "Characterization of Site Hydrogeology." The other sections were completed based only on the detection monitoring well network (MW-13, MW-20, MW-21, and MW-22) and the facility's Sampling and Analysis Plan. Supplemental information from the aforementioned reports and the Final Groundwater Sampling Inspection Report for the Collis, Inc. facility is provided in Attachments 2 through 9.

2.0 FACILITY DESCRIPTION

The Collis, Inc. facility is located at 2005 South 19th Street in Clinton, Iowa (Lat. 41 N, Long. 90 W) (see Figure 4). The facility employs over 300 people and operates three shifts per day, five to six days per week. The plant is bounded to the north by Manufacturers Ditch; on the west by South 19th Street, beyond which are cultivated lands; on the south by an alley adjacent to a residential development; and on the east by a golf course (see Figure 1). The city of Clinton (population 35,000) lies to the northeast within a 3-mile radius of the site.

Collis Inc. manufactures steel refrigerator shelving from rolled steel and wire stock. Steel components are welded, cleaned, zinc plated or powder coated, and then lacquer coated, prior to packaging and shipping. A molten choline salt (corrosive) bath is used to strip parts which do not meet specifications. Zinc plating process operations include caustic cleaning (by soaking or electric methods), acid pickling, zinc chloride electroplating, and a water rinse.

Electroplating wastewaters and sludges are routed to the onsite wastewater treatment plant where hexavalent chromium is reduced to trivalent, fluoride is removed, pH is adjusted, and solids are removed. Treated effluent is discharged to

Manufacturers Ditch under NPDES Permit No. IA0000752. Treated sludges are dewatered by a filter press; filter materials (which have been tested and are not hazardous) are disposed of at the local sanitary landfill.

2.1 Waste Management Practices in Regulated Units

From 1971 to 1979 five surface impoundments received wastewater treatment sludges and cyanide plating bath sludges. Cyanide plating operations were discontinued by the facility in 1985. Sludge materials were hazardous due to the presence of cyanide, chromium, zinc, and high pH. In 1982, the Superfund division of U.S. EPA Region VII requested that Collis install groundwater monitoring wells to determine if groundwater underlying the impoundments was contaminated. Terracon completed the Hydrogeological Assessment, Phase I, Part 1, in September 1983. Terracon completed soil borings at twelve locations. Groundwater monitoring wells were installed in five of the locations (MW-1 through MW-5) and piezometers were installed in six of the locations (P-1, P-6, P-7, P-9, P-10, and P-11). Analytical data from the sampling of two of these wells (MW-2 and MW-5) have been submitted to the U.S. EPA Region VII on a quarterly basis; however the location of MW-2 (cross-gradient) and the high concentrations of TOX in background well MW-5 indicated that additional wells should be installed at locations more suited to monitoring the potential impacts of the surface impoundments.

Terracon completed the Hydrogeological Assessment, Phase I, Part 2, in July 1984. Terracon advanced three soil borings; a groundwater monitoring well was installed in one of the locations (MW-13) and piezometer points were installed in two of the locations (P-14 and P-15). Of the six monitoring wells installed during Parts 1 and 2 of the Phase I Hydrogeologic Assessment, only one well (MW-13) was suitable for subsequent use as a RCRA monitoring well based on location and well construction criteria.

Collis is an interim status Treatment/Storage/Disposal facility (due to the sludges stored in the impoundments) and had submitted a Part A Permit Application to the EPA. Rather than submit a RCRA Part B Permit Application to the EPA, to obtain a permit to operate the surface impoundments, Collis elected to close the waste management units. Following EPA approval of Closure and Post-Closure Plans submitted by the facility, closure activities (sludge excavation and disposal followed by confirmatory sampling of residuals) were initiated in early 1987. Post Closure activities yet to be completed include completion of the groundwater monitoring program and backfilling and regrading of the former impoundment excavation. The groundwater monitoring program will be an ongoing activity for the next few years. Collis anticipates to begin backfilling of the impoundments by August 15, 1988 with Certification of Closure by October 1, 1988.

In July 1988, Warzyn reported that additional borings were completed at eleven locations. Groundwater monitoring wells were installed in three of those locations (MW-20, MW-21, and MW-22).

The final RCRA groundwater monitoring network consists of four wells; three downgradient wells (MW-13, MW-20, and MW-21) and a single upgradient well (MW-22) (see Figure 2). Collis is currently implementing their detection monitoring program. The first four rounds of sampling were conducted on March 18, April 13, May 12, and June 9, 1988.

2.2 Other Facility Practices/Components That May Affect Groundwater Quality

Effluent from the Collis wastewater treatment plant may have produced statistically significant increases in the concentrations of copper, cyanide, and zinc in Manufacturers Ditch, downstream of the NPDES outfall. The pre-treatment system includes a concrete-lined settling basin that is as deep as 18 feet at its southern end. If the settling basin were to leak, untreated wastewaters may leach into underlying soils and groundwater.

Observations of soil samples collected during the drilling programs at the site have suggested oily substances and other organic compounds are present in the subsurface in the vicinity of the surface impoundments. Oily sheens and red-orange staining were observed on waters that had accumulated in the former surface impoundments. Soils along the water/embankment interface appeared to be stained dark gray to black.

Other factors potentially affecting groundwater quality at the site may include unanticipated spills or leaks in the vicinity of the monitoring wells. For example, during the August 10, 1988 groundwater sampling inspection it was noted that purged waters collected as a result of well evacuation were discharged to the ground surface within 20 feet of the detection monitoring wells

2.3 Regulatory Status

Chamberlain Manufacturing Coporation was the former owner and operator of the Collis, Inc. facility in Clinton, Iowa. In June 1980, Chamberlain submitted to the EPA a Notification of Hazardous Waste Activity indicating that the facility generates, transports, treats, stores, or disposes of hazardous wastes (identified as F006, F007, and F008) from non-specific sources. In November 1980, Chamberlain submitted to EPA its Part A Hazardous Waste Permit Application identifying itself as an electroplater of wire products and listing its hazardous waste process as that of storage in surface impoundments and treatment and storage in tanks.

In March 1982, Chamberlain submitted a revised Part A permit application identifying hazardous waste from non-specific sources as F006, F008, and F009.

In January 1983, Chamberlain and the CERCLA branch of the EPA entered into a Consent Order pursuant to Section 3013 of RCRA, 42 U.S.C. Section 6934 for the implementation of an environmental monitoring program at the facility. The two-phased Order required Chamberlain to initiate a hydrogeologic investigation, monitoring and analysis, and to determine the need for additional shallow and deep monitoring wells. The groundwater monitoring system developed in accordance with the Consent Order was not required to meet the criteria specified in 40 CFR 265 Subpart F. In August 1983, the Office of Solid Waste and Emergency Response issued a memorandum clarifying the status of inactive/active storage and disposal facilities under RCRA. In part, the memo stated, "...any facility which is storing hazardous waste placed onsite on or before November 19, 1980, is an active storage facility and is subject to the provisions of RCRA, even if no hazardous waste was placed onsite after November 19, 1980. This applies to storage in surface impoundments.... if a waste pile or surface impoundment is a storage facility, it should be managed in accordance with the interim status requirements...."

In May 1984, Collis, Inc. submitted a revised Part A permit application to reflect a change in ownership from Chamberlain Manufacturing Corporation to Collis, Incorporated. Hazardous wastes treated and stored in tanks were noted as being removed from the facility within 90 days. In August of 1984, Collis also submitted to the EPA a closure plan for its hazardous waste storage surface impoundments. In September of 1984, the EPA informed Collis that groundwater and soil contamination had occurred at the site and that remedial measures were warranted to prevent the release of additional contaminants from the surface impoundments. In November 1984, Colis submitted to the EPA a post-closure plan for the surface impoundments.

In April 1985, Collis submitted to the EPA a report on "Potential Releases from Solid Waste Management Units." According to this report, the surface impoundments received electroplating waste sludges from the facility's settling tanks from 1970 to 1979; thus, the surface impoundments are subject to RCRA authority. In November 1985, the EPA provided Collis with comments on both the closure and post-closure plans; Collis submitted responses to the EPA regarding these comments in Feburary of 1986.

In September 1986, a RCRA Compliance Evaluation Inspection (CEI) was conducted at the facility by representatives of the EPA. The following groundwater monitoring violations were noted:

1. Monitoring wells were not located at the boundaries of the waste management area, contrary to 40 CFR 265.91(b)(2).
2. Collis had not obtained and analyzed samples from each of its installed groundwater monitoring wells, contrary to the requirements of 40 CFR 265.92(2). Data was presented only for two of its monitoring wells.

In March 1987, the EPA requested information from Collis regarding closure activities for the surface impoundments which had taken place todate. In response to the EPA request, Collis stated that removal of the hazardous waste sludge was performed during the period from November 11, 1986 until February 13, 1987. Sludge was transported to an offsite hazardous waste disposal facility from December 14, 1986 to February 17, 1987. The hazardous waste sludge (F006) currently generated is stored onsite for less than 90 days prior to transport to an off-site hazardous waste disposal facility.

Collis submitted Closure and Post-Closure Plans for the regulated units, and a Sampling and Analysis Plan which included construction and design proposals for three additional detection monitoring wells (MW-20, MW-21, and MW-22) and proposed sample collection, handling, and analysis procedures. Provisions for the statistical analysis of groundwater monitoring data were not provided by the facility.

The EPA approved Collis' closure plan in March 1987. Post-closure monitoring was to be performed in accordance with the facility's Sampling and Analysis Plan submitted to the EPA in November 1987 and included in Attachment 7.

The detection groundwater monitoring program was initiated in March of 1988 in accordance with the Sampling and Analysis Plan. Groundwater samples have been collected in March, April, May, June, and August of 1988. Analytical results have been submitted to the U.S. EPA Region VII for the first four sampling rounds. The Sampling and Analysis Plan provides for an accelerated background data collection program. However, the analytical parameters specified in the Sampling and Analysis Plan do not include Appendix III constituents as required by 40 CFR 265.92 (b)(1). Collis has not provided any statistical evaluations for sampling data obtained from the detection monitoring network. In addition, Collis has not provided a groundwater assessment plan outline as required by 40 CFR 265.93. The facility is currently operating under detection monitoring status.

3.0 REGIONAL HYDROGEOLOGY

3.1 Owner/Operator Information

The following information was obtained from the "Hydrogeologic Assessment" report prepared by Terracon in September 1983. No other information was provided by the facility concerning regional hydrogeology.

Clinton County is in the central part of the eastern boundary of Iowa west of the Mississippi River. The county has several areas of distinct physiography, the Kansan-Nebraskan Glacial Till Plain, the "Iowa Erosion Surface", and the alluvial flood plain associated with the Mississippi River, the Wapsipinicon River, and Goose Lake Channel. The Collis facility is situated on the alluvial flood plain associated with the Mississippi River which lies along the eastern boundary of the county. The Collis facility lies in an upland area of the Mississippi River flood plain which is drained by Manufacturers Ditch and Mill Creek. This valley is presumably the result of a former channel of the Mississippi River. The area is dominated by nearly level, moderately well drained and poorly drained soils of the Colo and Sawmill Series. These poorly to moderately well drained soils are formed in silty alluvium on flood plains.

Surface topography does not reflect the top of bedrock surface which appears to be somewhat erratic as a result of erosion. The surface bedrock unit in Clinton county is a Silurian dolomite, of Niagaran Age. The first bedrock encountered beneath the site appears to be the Anamosa Formation of the Gower Dolomite, a soft, yellowish brown, and thinly-bedded dolomite and limestone. Information presented in these two paragraphs is the approximate extent of regional hydrogeologic information provided by Collis. The additional information on regional hydrogeology presented below is provided so that the regional aquifers and potential flow systems may be considered.

3.2 Other Available Information

Clinton County and the City of Clinton depend on the Silurian, Cambrian-Ordovician, and Dresbach aquifers as sources of domestic and public water supply in addition to the surface water resources (Mississippi River). The Silurian aquifer includes the Niagara age Gower dolomite, Hopkinton dolomite, Kankakee limestone, and the Edgewood dolomite. The Gower dolomite is commonly the first bedrock formation encountered in the Clinton area. The Niagara limestones and dolomites range in thickness from 90 to 224 feet in the vicinity of Clinton and are underlain by the Maquoketa shale, described as a greenish-gray shale approximately 200 feet thick. (The Maquoketa shale aquitard is a member of the Ordovician confining beds.)

The Silurian aquifer (Niagara age formations) outcrops along the eastern edge of the City of Clinton and is capable of yielding from 10 to 300 gpm to wells. The Silurian aquifer is the first bedrock aquifer encountered in the vicinity of the site and is commonly tapped by private domestic supply and irrigation wells. The deeper Cambrian-Ordovician aquifer (Jordan Sandstone) and the Dresbach Sandstone aquifer are commonly tapped by industrial and municipal supply wells due to the better water quality and greater potential yields. The hydrologic units summarized above are presented on Figure 3. (Reference: Iowa Geological Survey

Bureau, 1978, Water Resources of East-Central Iowa, Water Atlas No. 6.)

Four wells were identified at or immediately adjacent to the Collis, Inc. facility in Iowa Geological Survey Bureau and U.S. Geological Survey Cooperative Files and are shown on Figure 4. Three of these wells presumably penetrate the shallow alluvial/fill aquifer and possibly, the upper horizons of the Silurian aquifer. The depths for these three wells range from 17 to 60 feet. A fourth well taps the Cambrian-Ordovician aquifer at a depth of 1633 feet. This well is presumably the process water supply well at the Collis facility. Lithologic descriptions for these four wells are provided in Figure 5. Two other wells were identified within a 1/2-mile radius of the site. These wells tap the deep Cambrian-Ordovician and Dresbach aquifers. Lithologic descriptions for these deep wells are provided in Figure 6.

Unconfined water-bearing aquifers consist of unconsolidated alluvial deposits of Quaternary age, buried channel deposits, and glacial drift. The area of the Collis facility is underlain by glacial drift and small buried channel deposits. Since the site is in an upland area, silty to clayey low permeability loess deposits form the uppermost water-bearing horizon. The thickness of the loess and underlying alluvial deposits varies from 0 to 350 feet in the area of the site, the result of buried channels and erosional irregularities in the underlying bedrock surface. Recharge to the unconsolidated deposits is primarily from the infiltration of precipitation.

Manufacturers Ditch is a concrete-lined tributary to Mill Creek. Mill Creek flows in a southerly direction towards the Mississippi River. Alluvial silts and sands encountered in the Manufacturers Ditch and Mill Creek drainage areas are not highly transmissive. Recharge to the alluvium is primarily through the infiltration of precipitation and surface waters.

3.3 Adequacy of Owner/Operator Information

Collis, Inc. does not present an adequate overview of the regional geologic or hydrologic setting as part of their detection groundwater monitoring program. In addition, the information provided by Collis, Inc. does not provide the relationship between the facility and the underlying regional aquifer systems.

4.0 CHARACTERIZATION OF SITE HYDROGEOLOGY

4.1 Review of Facility Investigatory Techniques

There are a variety of investigatory techniques available to define the hydrogeology beneath the site. Some of the investigatory techniques available to Collis are as follows:

- o Literature survey of regional hydrogeologic data.
- o Direct investigatory techniques such as soil boring, piezometer and well installation, pump tests, etc.
- o Indirect investigatory techniques such as geophysical well logging, tracer studies, seismic surveys, hydraulic conductivity measurements of soil samples or cores, etc.

Collis used only direct techniques to investigate site hydrogeology. Over 26 boreholes were drilled; groundwater monitoring wells were installed at 9 of these locations and piezometers were completed at 8 of these locations. Boring logs and location maps for most of the 26 boreholes are included in Attachment 2. Soil samples collected from the boreholes were given a descriptive classification (Unified Soil Classification System) and were tested for cation exchange capacity, water content, and dry density. Although no pumping tests were performed, slug tests were employed to measure the hydraulic conductivities of the saturated soils outside of the screened intervals. Slug test procedures and results are provided in Attachment 3. Presumably qualified personnel were utilized during these investigations although no documentation was provided.

Collis did not use indirect techniques to investigate site hydrogeology and supplied only limited information from the existing literature. No U.S.G.S. maps, soils maps, regional hydrologic maps, water supply well logs, or regional maps of the area that surrounds the facility were provided. Apparently the extent of Collis' literature review was contained in the first two paragraphs of the Regional Hydrogeology Section (see Section 3.0) of this report. No regional aquifers or aquitards were defined.

4.2 Owner/Operator Information

4.2.1 Characterization of Subsurface Geology

Collis, Inc. characterized the subsurface geology of the site by drilling boreholes and sampling subsurface materials using split-spoon or shelby tube samplers. Boring logs are included in Attachment 2. Hollow-stem augers were used to advance all of the borings. Some of the boreholes were completed as monitoring wells and some as piezometers. Continuous samples were obtained from boreholes which were subsequently completed as monitoring wells (except for well MW-13); discontinuous samples were obtained from the remaining borings. Borehole spacing was adequate to define the site subsurface geology although the use of surface geophysical investigatory techniques probably would have improved the interpretation between boreholes. Presumably the drilling of boreholes and logging of samples was performed by qualified personnel although no documentation was provided.

When characterizing the subsurface geology of the site, the borings should be drilled to the depth of the first confining unit (if present) below the uppermost zone of saturation. Collis, Inc. failed to drill deep enough to delineate an upper aquifer and an underlying confining unit. Generally boreholes were drilled to the top of the limestone, while some borings were advanced into the limestone rubble (weathered limestone on top of the limestone bedrock). The limestone was not identified as a confining layer, and Jacobs' assessment of regional hydrogeology suggests that the Anamosa Formation may be part of the regional Silurian aquifer. The facility did not attempt to investigate the horizontal and vertical hydraulic conductivities of the limestone or address the presence of possible Karstic features.

None of the boring logs contained all the information that could be expected. Generally the driller's and geologist's names, hole location, drill rig type and bit/auger size, and narrative descriptions were missing.

Cation exchange capacity, water content, and dry density were performed on many of the borehole samples. Additional analytical tests that could be performed on the borehole samples were not utilized. These tests include mineralogy, petrographic analysis, falling head tests, static head tests, settling measurements, centrifuge tests, and column drawings.

4.2.2 Characterization of Site Hydrology

The Collis, Inc. facility lies south of Manufacturers Ditch, a concrete-lined tributary to Mill Creek, a primary tributary to the Mississippi River. The uppermost bedrock strata encountered beneath the site is the Anamosa Formation of the Gower Dolomite, a soft, yellow-brown, thinly bedded dolomitic limestone. The bedrock surface beneath the site is highly irregular, the probable results of wind and water erosion. Two buried bedrock valleys appear to be present. One lies in the southwest corner of the site (running through boring 12) and the second is near the north-central portion of the plant building and slopes downhill towards the north (towards the area of the surface impoundments). An isopach map of the bedrock surface is provided in Attachment 2. Depths to bedrock range from a few feet (in the north-central and southeastern portions of the site) to nearly 120 feet in the southwestern corner of the site (see Attachment 2 for cross-sections of the site).

Silty to clayey fill materials and alluvial sands and gravels overlie the bedrock. The coarser materials are encountered at depth (elevations 565 to 585 feet above MSL). The fill materials consist of dark brown to dark gray silts with varying amounts of clay, organic matter, cinders, and gravels. Fill materials are present at depths of 5 to 12 feet below grade. Beneath the fill, clayey silt to silty alluvial deposits were noted with occasional sand seams encountered between depths of 12 and 19 feet in MW-13. Traces of sand were also noted in the boring log for MW-22. However, significant sand seams do not appear to extend north of the bedrock ridge in the north-central portion of the site. Boring logs for piezometers and monitoring wells are also provided in Attachment 2.

4.2.3 Identification of Groundwater Flow Paths

The groundwater flow direction in the saturated soil/fill was determined from water level measurements made in the monitoring wells and piezometers. All available water level measurements are included in Attachment 4. The groundwater elevation measurements are not as precise as they should be because the well casing heights were not measured to the nearest 0.01 foot and water level measurements were not reported to the nearest 0.01 foot. Presumably a licensed surveyor was used to survey the casing elevations although no documentation was presented.

Upward vertical hydraulic gradients were measured at two locations (MW-1 and MW-9) in the southwest corner of the site; however, it is unclear whether the multiple piezometers were placed in a single borehole or multiple boreholes. Available well and piezometer construction details are included in Attachment 5. The two multiple piezometer locations are not in close proximity to the surface impoundments and only categorize vertical hydraulic gradients in the soil/fill. Vertical gradients in the soil/fill in the vicinity of the surface impoundments have not been determined, and hydraulic gradients in the limestone beneath the site have not been determined. There is no clearly documented rationale for the completion depth of the monitoring wells and they are generally completed at varying depths. Some of the monitoring wells were completed in the limestone rubble and some in clay, silt, sand, or fill material.

Collis provided adequate water table contour maps for the soil/fill/alluvial aquifer beneath the site; however, no water table maps were developed for the limestone bedrock. Hydrologic cross sections of the vertical flow component across the site were not provided.

Several of the soil/fill ground water contour maps document fluctuations in ground water levels and flow directions, however an explanation for these fluctuations was not provided by the facility. Collis should evaluate whether or not the fluctuations in groundwater elevation are seasonal, a result of offsite pumping or land use, or related to onsite pumping. No data are presented concerning fluctuations in groundwater levels and flow directions in the limestone at the site. Collis did not implement a means for gauging long term effects on groundwater movement that may result from onsite or offsite construction or changes in landuse patterns.

Slug tests were performed on monitoring wells MW-1 through MW-5; however, slug tests are accurate at measuring hydraulic conductivities of saturated materials only in the immediate vicinity of the screened interval. The slug test procedure was not well documented. Slug test-derived hydraulic conductivities calculated for wells MW-1 through MW-5 varied over three orders of magnitude and may indicate that the wells were not screened consistently in the same strata or material. Aquifer pumping tests are a more accurate means of determining aquifer hydraulic conductivity and can also test the hydraulic connection between different geologic strata. Other parameters such as transmissivity, storage coefficient, leakage, permeability, porosity, and specific capacity were not determined by Collis for either the saturated soil/fill or limestone bedrock horizons.

4.3 Other Available Information/Independent Assessment

The topography across the Collis, Inc. facility varies from almost 600 feet NGVD at the southeast corner of the site to 583 feet NGVD at the northeastern portion of the site. A topographic low lies immediately northeast of the surface impoundments (near MW-3). This area is prone to flooding and groundwater seepage during periods of rain and high groundwater conditions. Groundwater also has filled the area of the former surface impoundments; the water surface in the impoundments had oily sheens and red-orange staining.

Boring logs produced during the drilling program suggest the fill materials are low-permeability silts and clays, high in organic content with discontinuous sand stringers. The presence of a buried bedrock channel in the vicinity of the surface impoundments was indicated by the facility, as most wells were bottomed into weathered bedrock (with the exception of MW-20). Monitoring well MW-20 was not bottomed in bedrock, thus the potential exists for contaminants in the lower alluvial horizons to remain undetected at this location, especially if the contaminants are denser than water.

Groundwater flow beneath the impoundments is towards the north and northeast in the direction of the marshy area and Manufacturers Ditch. Groundwater elevations and the resulting groundwater flow directions beneath the impoundments during drier months (May and June 1988) suggests that the water accumulated in the impoundments may be recharging the groundwater (see Attachment 4). Available information did not allow for a complete assessment of seasonal fluctuations, artificially induced groundwater variations, or communication between the fill/alluvium and underlying bedrock strata.

Examination of the lithologic descriptions for the onsite deep well (Figure 5) suggests the Silurian aquifer is approximately 157 feet thick, beneath which lies a 210-foot thick sequence of Maquoketa shales (presumably, the uppermost aquitard). The Silurian strata are primarily dolomites. Ordovician water-bearing strata are then encountered at the interval of 375 to 1160 feet below grade, beneath which Cambrian strata are penetrated to a total well depth of 1633 feet. There does not appear to be a confining layer between the fill/alluvial sediments and the underlying Silurian dolomite, thus the uppermost aquifer appears to include both the fill/alluvium and Silurian dolomites. The presence of vertical hydraulic gradients between the fill/alluvium and Silurian dolomites could not be assessed from available information.

4.4 Adequacy of Owner/Operator Information

The subsurface geology at the Collis site consists of predominantly silty to clayey fill soils, a weathered limestone rubble layer, and the underlying limestone bedrock of the Anamosa Formation. Collis adequately characterized the soil/fill horizon but did not adequately characterize the limestone rubble and bedrock. Insufficient data were collected to adequately define limestone petrography, geochemistry, and subsurface geologic variations. In addition, the hydrogeologic assessment does not address or provide means to resolve any of these information gaps.

Collis did not define the uppermost aquifer, confining layer (if present), or identify a lower aquifer. In addition, the horizontal and vertical components of ground-water flow were not adequately established for either the soil/fill or the limestone in the vicinity of the surface impoundments. Horizontal flow in the soil/fill was determined although no determination was made concerning what strata within the soil/fill would transmit the most ground water. Vertical hydraulic gradients (upward) in the soil/fill were identified in the southwest corner of the site, but vertical hydraulic gradient data were collected in the vicinity of the surface impoundments. Data to determine both horizontal and vertical hydraulic gradients in the underlying limestone rubble and bedrock horizons at the Collis Inc. site were not obtained.

Site-specific information presented by the facility regarding identification of the uppermost aquifer (as opposed to the water-bearing horizons of the fill/alluvium monitored at the site) and uppermost aquitard is inadequate. Information presented by the facility addressed only the monitored fill/alluvial sediments which may be in hydraulic communication with underlying bedrock strata. Identification of the extent of communication between the fill/alluvium and underlying bedrock limestones and dolomites has not been determined. In addition, site-specific information does not address the extent of seasonal fluctuations, artificially induced variations, or groundwater flow components in the bedrock strata which may affect groundwater elevations.

The facility has not identified the groundwater quality of the uppermost aquifer as required by 40 CFR 265.91(a)(1) and (2).

5.0 GROUNDWATER MONITORING SYSTEM EVALUATION

Following the issuance of a Compliance Order, Collis installed three additional detection monitoring wells (MW-20, MW-21, and MW-22) in accordance with their Sampling and Analysis Plan and proposed detection groundwater monitoring program (under 40 CFR 265.91). Collis currently is sampling under an accelerated background water quality sampling schedule for MW-22 as requested by U.S. EPA Region VII. Statistical analyses by which monitoring data are to be evaluated have not been provided by the facility.

5.1 Placement of Detection Monitoring Wells

5.1.1 Placement of Downgradient Wells

The five surface impoundments are combined into one waste management area. The placement of the downgradient detection monitoring wells (MW-13, MW-20, and MW-21) is adequate to detect immediately any statistically significant amounts of hazardous waste that may migrate from the waste management area, presuming an upward gradient exists between the alluvial and bedrock aquifers. Collis did not document the rationale for the location of the detection monitoring wells, the density of the wells, or the screen lengths used in the construction of the detection monitoring wells. The number of downgradient detection monitoring wells is marginal although it meets the minimum requirements of 40 CFR 265.91. The actual locations of wells MW-20 and MW-21 (see Figure 2) as determined during the Jacobs QA/QC audit were different than the proposed location indicated on Figure 2.

A review of the detection monitoring well boring logs indicated that MW-20 was not bottomed into bedrock. Thus, MW-20 may not be capable of detecting dense contaminants, if present, which may migrate along the fill/alluvium and weathered limestone interface.

5.1.2 Placement of Upgradient Wells

The placement of the upgradient monitoring well (MW-22) is adequate to yield groundwater samples that are representative of background groundwater quality in the upper saturated soil/fill soils (and part of the limestone rubble) near the waste management area although it is distant from the surface impoundments. No explanation was provided concerning the location of the well and its screen length. In addition, it is difficult to determine if the well was screened in the same portion of the soil/fill horizon as the downgradient monitoring wells because of the presence of a buried channel beneath the impoundments and due to the fact that the uppermost aquifer was not defined. The actual location of well MW-22 (see Figure 2) as determined during the Jacobs field audit was different than the proposed location.

5.2 Monitoring Well Design and Construction

5.2.1 Monitoring Well Design

Collis did not provide concise monitoring well construction summary sheets for ground water monitoring wells MW-13, MW-20, MW-21, and MW-22. Jacobs compiled summary sheets for these wells which are included in Attachment 1; however, some information was not available and therefore could not be included in the construction summary sheets.

5.2.2 Drilling/Installation Methods

The hollow-stem auger drilling method (6.25-inch inside diameter) was utilized to drill monitoring wells MW-20, MW-21, and MW-22. Presumably the same method was utilized to drill monitoring well MW-13, although Collis provided no well-specific description. No fluids or additives, which could contaminate groundwater samples, were used with the hollow-stem drilling method. Soil samples were collected at 2.5-foot intervals using a split-spoon sampler and Standard Penetration Test procedures (ASTM D1586). The entire drill rig was steam-cleaned prior to use at the site. Augers, tools, drill rods and related equipment were steam-cleaned between each boring, and the back of the drill rig was cleaned between borings as needed. The split-spoon sampler was cleaned between each use with a soap (liquinox or TSP-90) and water wash followed by a tap water rinse.

5.2.3 Monitoring Well Construction Materials

Two-inch diameter flush threaded PVC well casings and screens were used. Collis did not explain their choice of PVC construction materials. Stainless steel would have been a more ideal well construction material to use for these shallow monitoring wells; however, the PVC is probably adequate. Washed silica sand was used as gravel pack material for wells MW-20, MW-21, and MW-22. Presumably silica sand was also used for well MW-13 although Collis did not describe it. Bentonite pellets were used to form a 2-foot seal on top of the gravel pack. A cement/bentonite grout sealed the well to the ground surface. Steel protector pipes were set into cement grout at each well. Collis failed to indicate if the PVC casings and screens were steam-cleaned prior to installation.

5.2.4 Well Intake Design and Well Development

Five-foot lengths of two-inch diameter 0.010 slot size PVC screen were used in monitoring wells MW-20, MW-21, and MW-22, and ten feet of two-inch PVC screen were installed in well MW-13. Collis did not describe the screen slot size used in well MW-13 and did not indicate the manufacturer or the design of any of the well screens. All of the wells were developed by bailing with a PVC bailer. Wells MW-20, MW-21, and MW-22 were bailed until stable as indicated by three successive readings which varied by no greater than 0.5 units for pH and 5% for specific conductance. Well MW-13 was bailed until the specific conductance, pH, and temperature stabilized at 920 micromhos per centimeter, 6.03 pH units, and 13 degrees centigrade, respectively.

5.2.5 Annular Space Seals

Two feet of bentonite pellets were used to seal the borehole above the gravel pack in each monitoring well. Cement/bentonite grout sealed the boreholes to the ground surface. Steel protective pipes with locking covers were set into concrete at each well; however, Collis did not indicate if the protective pipe for well MW-13 had a locking cover (it did have a locking cover as confirmed in the Jacobs QA/QC field audit.)

5.2.6 Field Tests/Field Demonstration

On August 10 and 11, 1988 Jacobs Engineering Group performed a CME Quality Assurance/Quality Control (QA/QC) Field Audit at the Collis, Inc. facility. Observations made during the audit are included in Attachment 6. Observations made of detection monitoring wells MW-13, MW-20, MW-21, and MW-22 agree approximately with what Collis reported. Depths to water in the wells were greater than reported previously due to regional drought conditions potentially affecting shallow groundwater beneath the site.

5.3 Past Analytical Performance

The detection monitoring well network was completed by January 1988. Past analytical performance was evaluated based on sampling data provided for MW-13, MW-20, MW-21, and MW-22 for the March, April, May, and June sampling events. Table 1 provides a sample analysis summary for the first four sampling events. Analytical results are provided in Attachment 8. (Collis referenced the analytical methods used, but did not provide method detection limits for all analyses.)

Collis analyzed the samples from MW-22 in quadruplicate for RCRA groundwater contamination indicator parameters: pH, specific conductance, total organic carbon (TOC), and total organic halogens (TOX). (TOX analyses were not performed for MW-22 during the March 1988 sampling round because the sample bottle broke in transit to the analytical laboratory.) Statistical analyses have not been provided by the facility, thus comparisons between downgradient groundwater quality and upgradient water quality have not been made. Concentrations of contamination indicators suggest that background groundwater quality is slightly more acidic, less conductive, and contains lesser concentrations of TOC and TOX than downgradient monitoring wells MW-20 and MW-21. Groundwater quality in MW-13 appears to be significantly different from that in MW-20, MW-21, and MW-22; this is discussed in further detail in the following paragraph.

All detection monitoring wells were sampled for RCRA groundwater contamination indicators and general water quality parameters (phenols, iron, manganese, sodium, chloride, sulfate, and alkalinity) during the March 1988 sampling round. Collis did not specify in the Sampling and Analysis Plan that Appendix III parameters would be sampled for and analyzed; this is in violation of 40 CFR 265.92(b)(1). Groundwater quality indicators were detected in higher concentrations in downgradient wells MW-20 and MW-21 than in background (MW-22). Groundwater quality in monitoring well MW-13 appears to be significantly different from that in the other three wells with respect to water quality and contamination indicator parameters. Generally, the groundwater in MW-13 appears to be more dilute. Monitoring well MW-13 differs from the other three wells in well design and construction. MW-13 is the deepest well (total depth = 20 feet), compared to total depths of less than 10 feet for the other three wells; the screened interval in MW-13 is 10 feet (compared to 5-foot screen lengths in the other wells); and MW-13 is screened in slightly sandier strata (and less organic matter content) than the other wells. The monitoring well design and construction differences may be responsible for the apparent differences in water quality; these differences may hamper statistical analyses used to detect statistically significant differences as MW-13 has much lower concentrations than MW-22, the background well, for most parameters measured.

5.4 Adequacy of Groundwater Detection Monitoring System

The Collis, Inc. facility is currently operating under detection monitoring status. The well locations appear to allow for the immediate detection of a release provided that upward hydraulic gradients exist year-round between the fill/alluvium and underlying bedrock strata (this has not been verified by the facility). Well design and construction appear to affect the groundwater quality results obtained for MW-13; this well has a longer screened interval, is a deeper well, and penetrates sandier strata than the other three wells; thus the usefulness of this well in detecting statistically significant changes in concentration when compared to a background well with concentrations that are significantly higher may be limited. However, trend analyses for concentration changes in MW-13 may be useful to detect whether or not contamination is occurring. Monitoring well MW-20 may not be useful in detecting dense contaminants which may migrate along the fill/alluvium and bedrock interface, as this well was not bottomed into bedrock.

The location and screened interval of upgradient well MW-22 suggest the well is capable of providing representative groundwater samples from the saturated fill upgradient of the surface impoundments, although the well is more distant from the waste management units than is ideal. Upgradient alluvial materials are not monitored by the existing background well.

The design and construction of the detection monitoring wells was not adequately documented, and available information suggests the design and construction of MW-13 and MW-20 may hamper the detection of small but statistically significant changes in contaminant concentrations which may indicate a release is occurring. The wells should be structurally stable and appear to be sealed to prevent surface water infiltration, provided proper techniques were used to install annular bentonite and concrete/bentonite grout seals. Monitoring wells MW-20, MW-21, and MW-22 may produce more depth-discrete samples due to their shorter screened intervals than MW-13. The detection monitoring network at the Collis, Inc. facility violates 40 CFR 265.91(a)(2) and 265.91(c).

The detection monitoring system does not address the possibility of hydraulic communication between the bedrock and overlying sediments. It is possible that the bedrock may provide pathways for contaminant migration (violates 40 CFR 265.91).

Deficiencies in sample collection, handling, and management procedures may also affect groundwater quality data; these concerns were addressed in the "Final Report of RCRA Groundwater Sampling Inspection at the Collis, Inc. Facility" submitted to U.S. EPA Region VII on December 7, 1988. In addition, Collis did not adhere to their accelerated sampling schedule by failing to collect sufficient samples during the August 1988 sampling round (this is documented in the Final report referenced above).

Inasmuch as Collis has progressed with the detection monitoring program, a complete assessment of groundwater quality concerns cannot be addressed without identification of the uppermost aquifer beneath the facility. Additional information is needed to define the uppermost aquifer and aquitard beneath the site prior to assessing groundwater quality impacts. Therefore, based on the comments discussed previously and the requirements of 40 CFR Subpart F, the groundwater detection monitoring system for the Collis, Inc. facility is inadequate.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on Jacobs' interpretation of existing data; the findings of the August 10, 1988 Groundwater Sampling Inspection at the facility; the requirements of 40 CFR Part 265, Subpart F, and the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA, 1986). The summary checklist for the technical assessment is provided in Attachment 1. A listing of significant findings and conclusions of the technical assessment portion of the CME are provided below.

1. Regional hydrogeology was not adequately characterized by the facility. Potential aquifers, aquitards, regional groundwater flow paths, and the locations of water supply wells and other discharge points have not been identified. The uppermost aquifer was not identified by the facility in the discussion of regional hydrogeology.

2. Characterization of site hydrogeology considered only the upper soil/fill horizons. Information pertaining to the hydraulic and geologic characteristics of the underlying bedrock units, their hydraulic connection to the overlying saturated soil/fill, the potential for contaminant migration from the surface impoundments into the bedrock strata, and the likely migration pathways for contaminants have not been adequately addressed. Since the uppermost aquifer has not been identified, Collis is in violation of 40 CFR Part 265, Subpart F, Sections 265.90 (a) and 265.91(a)(1) and (2).

    a. For the purpose of defining the uppermost aquifer beneath the site, the facility may want to consider advancing additional borings into the bedrock. The boring program at a minimum should address the following:

        o The uppermost continuous bedrock beneath the site by extending borings at least 10 feet into the underlying confining layer or aquitard. Identification of physical and chemical parameters should include the determination of hydraulic conductivity, specific yield, porosity, fracture distribution and orientation, etc.

- o Additional borings should be logged by a qualified geologist or geotechnical engineer, and special drilling techniques and well designs should be used to prevent cross-contamination from groundwater in the fill/alluvium into underlying bedrock. Such a design may include telescoping monitoring wells.

- o In addition, the extent of hydraulic communication between adjacent water-bearing strata (fill/alluvium and bedrock) as well as hydraulic parameters as transmissivity, storage coefficient, and specific yield should be determined by in-situ pumping tests.

b. The detection monitoring well system does not identify all potential groundwater flow paths of the uppermost aquifer. In order to accomplish this, the facility should consider the following:

- o Establish reference elevations for present and future monitoring wells by surveying to the nearest 0.01 foot (using a licensed surveyor).

- o Collect a series of water-level measurements (to an accuracy of 0.01 foot) from all wells at the facility for at least one year to delineate groundwater flow directions and identify potential influences from the facility, seasonal fluctuations in groundwater elevation, and artificially induced variations in groundwater elevation.

- o Once groundwater flow and hydraulic gradients have been established, the detection monitoring system can be modified to include monitoring groundwater quality in the uppermost aquifer.

- o After the uppermost aquifer and background groundwater quality have been established, it is recommended that the facility continue with the detection monitoring program and prepare a plan outlining the proposed groundwater assessment program.

3. The placement and location of detection monitoring well MW-21 appears to be adequate to allow immediate detection of a release to the saturated soil/fill horizon in the immediate vicinity of the impoundments. However, there is no means by which the facility can evaluate whether or not the impoundments may be releasing contaminants to the underlying bedrock aquifer. Downgradient monitoring wells MW-13 and MW-20 may be compromised in their ability to immediately detect statistically significant contaminant concentrations due to well design (10-foot screened interval in MW-13) and installation procedures (MW-20 was not bottomed into the bedrock unit). The violation citations are the same as those indicated for Finding No. 2.

4. Monitoring well design and construction was not adequately documented; however, a review of the information provided suggests that the detection monitoring wells should produce groundwater that is representative of the saturated fill/alluvial horizons beneath the site, with the exceptions noted previously for monitoring wells MW-13 and MW-20.

5. A groundwater quality assessment program was not provided to U.S. EPA Region VII for review, thus statistical procedures for subsequent data analysis could not be evaluated. This is a violation of 40 CFR Part 265, Subpart F, Sections 265.92(c)(2); 265.93(a),(b),(e),and (f); and 265.94(a).

TABLES

TABLE 1
SUMMARY OF ANALYTICAL DATA
FOR COLLIS, INC.

(units in mg/l except as noted)

Well Number	Sampling Date	pH (units)	Specific Conductance (umhos/cm)	TOC	TOX	Phenols	Iron	Manganese	Sodium	Chloride	Sulfate	Alkalinity
MW-13	March 1988	7.27/7.32	770/775	<1.0/<1.0	<0.005/<0.005	0.009/0.10	<0.05/<0.05	0.11/0.16	17.7/18.0	34/35	77/78	292/302
MW-20	March 1988	7.18/7.20	2830/2830	41.0/42.5	0.625/0.600	0.009/0.010	5.64/4.93	0.64/0.68	528/550	212/214	99/97	1290/1300
MW-21	March 1988	6.94	2560	18.9	0.060	0.014	1.32	0.52	169	224	136	967
MW-22	March 1988	6.56	2120	20.1	*	0.010	0.44	2.54	81.4	151	395	735
		6.55	2120	20.0	*							
		6.57	2120	19.9	*							
		6.55	2120	20.0	*							
	April 1988	7.0/7.16	2620/2640	94/93	0.241/0.341	NA	NA	NA	NA	NA	NA	NA
		7.04/7.33	2620/2660	95/95	0.303/0.383							
		7.08/7.37	2630/2680	85/100	0.416/0.362							
		7.19/7.41	2640/2690	95/102	0.215/0.372							
	May 1989	6.79.6.94	2640/2640	88/89	0.075#	NA	NA	NA	NA	NA	NA	NA
		6.93/7.04	2660/2640	104/100	0.146#							
		6.97/7.09	2650/2640	101/106	0.374#							
		7.01/7.08	2670/2650	105/86	0.114#							
	June 1988	6.86/6.89	2410/2400	66	0.075#	NA	NA	NA	NA	NA	NA	NA
		6.93/6.92	2430/2460	83	0.146#							
		7.09/7.03	2430/2450	88	0.374#							
		7.11/7.07	2440/2460	72/83	0.114#							

Abbreviations: TOC = Total Organic Carbon; TOX = Total Organic Halogens

Notes: NA = Not Analyzed; * = Sample bottle broke in transit to the laboratory;
= Data for TOX for the May 1988 and June 1988 parameters are identical - should evaluate whether this is a typographical error on the part of the analytical laboratory - if so, corrections should be made to the laboratory reports.

FIGURES

Figure 1. Site Plan - Collis, Inc.

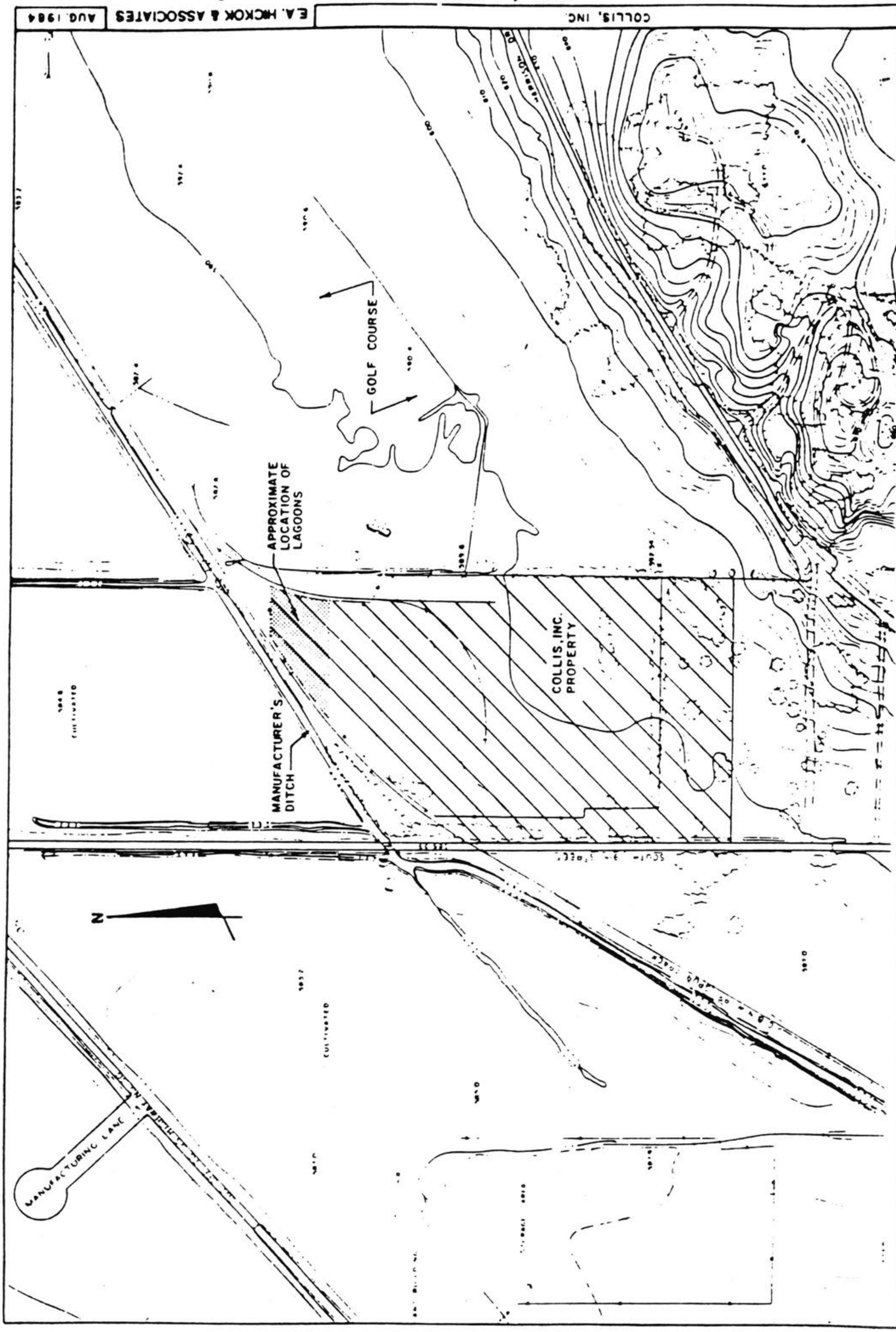


Figure 2. Monitoring Well Locations - Collis, Inc.

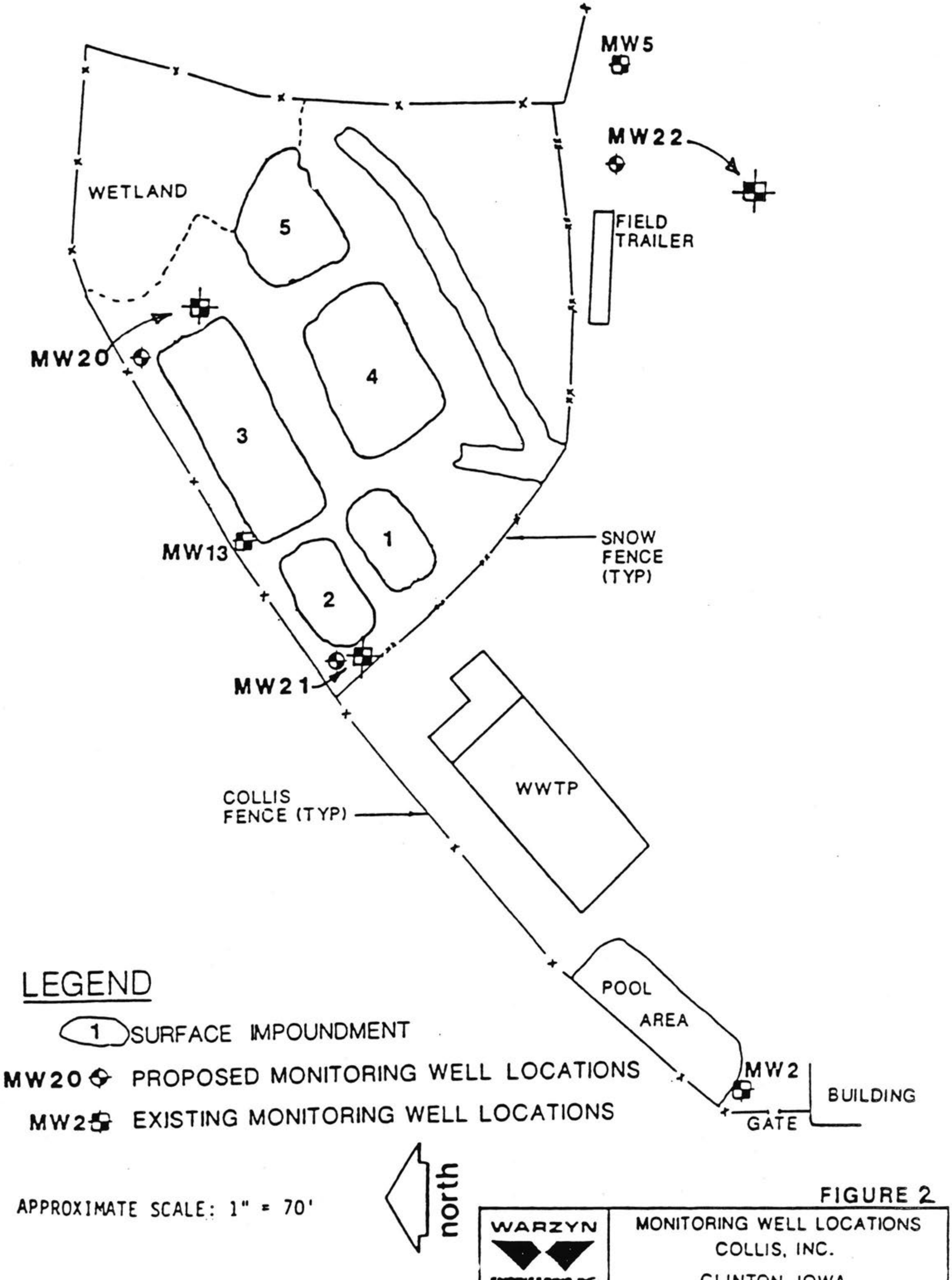


Figure 3. Hydrologic Units in East-Central Iowa.

Hydrologic unit	General thickness in feet	Age of rocks	Name of rock units	Type of rock
Surficial aquifers alluvial buried-channel drift	0 to 400	Quaternary (0 to 1 million years old)	Quaternary deposits, undifferentiated	Sand, gravel, silt, and clay Sand, gravel, silt, and clay Till (sandy, pebbly clay) sand, and silt
Pennsylvanian rocks principally confining beds; locally contains waterbearing sandstone	0 to 70	Pennsylvanian (280 to 310 million years old)	Pennsylvanian rocks, undifferentiated	Shale, sandstone, limestone, and coal
Mississippian aquifer	0 to 220	Mississippian (310 to 345 million years old)	Meramecian Series Osagean Series Kinderhookian Series	Limestone and sandstone Dolomite, limestone, and shale Limestone, dolomite, and siltstone
Devonian confining beds	0 to 350	Devonian (345 to 400 million years old)	Yellow Spring Group Lime Creek Shale	Shale, dolomite and siltstone Dolomite and shale
Devonian aquifer	0 to 400		Cedar Valley Limestone Wapsipinicon Limestone	Limestone and dolomite Dolomite, limestone, and shale
Silurian aquifer	0 to 450	Silurian (400 to 425 million years old)	Gower Dolomite * Hopkinton Dolomite Kankakee Limestone Edgewood Dolomite	Dolomite, with some chert and limestone
Ordovician confining beds	300 - 600	Ordovician (425 to 500 million years old)	Maquoketa Shale Galena Dolomite Decorah Formation Platteville Formation	Dolomite and shale Dolomite and chert Limestone and shale Limestone and shale
Cambrian-Ordovician aquifer	400 to 650		St. Peter Sandstone Prairie du Chien Formation Jordan Sandstone St. Lawrence Dolomite	Sandstone Dolomite, sandstone, and shale Sandstone Dolomite
Cambrian confining beds	90 - 290	Cambrian (500 to 600 million years old)	Franconia Sandstone	Shale, siltstone, and sandstone
Dresbach aquifer	157 to 1644		Dresbach Group Galesville Sandstone Eau Claire Sandstone Mt. Simon Sandstone	Sandstone Sandstone, shale, and dolomite Sandstone
Precambrian rocks		Precambrian (600 to more than 2 billion years old)	Crystalline rocks, undifferentiated	Sandstone, igneous and metamorphic rocks.

*Upper part includes the LaPorte City Chert in the northwest part of the report area.

The nomenclature and classification of rock units in this report are those of the Iowa Geological Survey and do not necessarily coincide with those accepted by the U.S. Geological Survey.

Reference: Iowa Geological Survey Bureau (1978) Water Resources of East-Central Iowa, Water Atlas No. 6.

Figure 5. Lithologic Descriptions of Wells on or Adjacent to the Collis, Inc. Facility.

SYSTEM	SERIES	GROUP	FORMATN	MEMBER	DEPTH TOP	DEPTH BOT	ELEV. OF TOP	THICK-NESS	CONTACT SOURCE	ACCURACY TOP	ACCURACY BOT	LITHOLOGY PRIMARY	LITHOLOGY SECONDARY	LITHOLOGY MINOR

COUNTY CLINTON SEQUENCE 7
LOCATION NE SE NW 14 T081N R05E LAT & LONG 41 49 30N 90 13 45W W-NUMBER 07711 DEPTH 39 ELEVATION 595 (Topo)

[redacted]

COUNTY CLINTON SEQUENCE 10
LOCATION NE SE NW 14 T081N R05E LAT & LONG 41 49 33N 90 13 45W W-NUMBER 13978 DEPTH 1633 ELEVATION 564 (Alt)

SYSTEM	SERIES	GROUP	FORMATN	MEMBER	DEPTH TOP	DEPTH BOT	ELEV. OF TOP	THICK-NESS	CONTACT SOURCE	ACCURACY TOP	ACCURACY BOT	LITHOLOGY PRIMARY	LITHOLOGY SECONDARY	LITHOLOGY MINOR
			sample gap		0	8	584	8						
Silurian	--------				8	160	576	152	Samples	poor	good	Dolomite	Chert	Shale
	--------	--------	Mosalem/		160	165	424	5	Samples	good	good	Dolomite	Chert	
Ordovicn	Cincinna	--------	Maquoket		165	375	419	210	Samples	good	good	Shale	Dolomite	
				Elgin	375	395	209	20	Samples	fair	good	Shale	Dolomite	
	Champlai	Galena	Dub /Wis		395	625	189	230	Samples	good	good	Dolomite		
			Decorah	Guttenbg	625	660	-41	35	Samples	good	fair	Dolomite		
		--------	Plattevl	McGregor	660	705	-76	45	Samples	poor	poor	Dolomite	Limestone	Chert
				Pecatoni	705	730	-121	25	Samples	fair	good	Dolomite	Limestone	
		Ancell	Glenwood	Harmony	730	738	-146	8	Samples	good	good	Shale		
			St Peter		738	798	-154	60	Samples	good	good	Limestone	Shale	
	Canadian	Prairie	Shakopee	Willow R	798	940	-214	142	Samples	good	good	Dolomite	Sandstone	Chert
				New Rich	940	980	-356	40	Samples	good	good	Dolomite	Sandstone	Chert
			Oneota		980	1160	-396	180	Samples	good	fair	Dolomite	Chert	
Cambrian	St Croix	Trempeal	Jordan		1160	1245	-576	85	Samples	poor	poor	Dolomite	Sandstone	Chert
			St Lawre		1245	1395	-661	150	Samples	fair	good	Dolomite	Sandstone	
		Tunnel C	LoneRock		1395	1550	-811	155	Samples	good	good	Sandstone	Dolomite	Shale
		ElkMound	Wonewoc	Ironton	1482	1550	-898	68	Samples	good	good	Sandstone		
			Gales /E		1550	1633*	-966	83*	Samples	good		Sandstone	Shale	
			Wonewoc	Galesvil	1550	1630	-966	80	Samples	good	good	Sandstone		
			EauClair		1630	1633*	-1046	3*	Samples	good		Sandstone	Shale	

THIS DATA RETRIEVED FROM THE GSB AND USGS COOPERATIVE GEOLOGIC FILE (PHONE 319-335-1575)

Figure 6. Lithologic Descriptions of Wells Within a 1/2-Mile Radius of the Collis, Inc. Facility.

COUNTY CLINTON SEQUENCE 1
LOCATION SE SE SW 11 T081N R06E LAT & LONG 41 49 49N 90 13 48W W-NUMBER 05220 DEPTH 2202 ELEVATION 591 (Alt)

GEOLOGICAL UNIT SYSTEM	SERIES	GROUP	FORMATN	MEMBER	DEPTH TOP	DEPTH BOT	ELEV OF TOP	THICK-NESS	CONTACT SOURCE	ACCURACY TOP	ACCURACY BOT	LITHOLOGY PRIMARY	LITHOLOGY SECONDARY	LITHOLOGY MINOR
Quatern	Pleistoc	Holocene	Recent		0	20	591	20	Samples	good	good	Soil-fill		
		undiff			20	65	571	45	Samples	good	poor	Clay	Fill	Sd & Grav
Silurian	--------	--------	Blanding		65	145	526	80	Samples	poor	good	Dolomite	Chert	
			Mosalem/		145	155	446	10	Samples	good	good	Dolomite		
Ordovicn	Cincinna	--------	Maquoket	Brainard	155	230	436	75	Samples	good	good	Shale	Dolomite	
				Ft Atkin	230	363	361	133	Samples	good	good	Shale	Dolomite	
				Elgin	363	380	228	17	Samples	good	good	Shale	Dolomite	
	Champlai	Galena	Dub /Wis		380	490	211	110	Samples	good	good	Dolomite	Chert	
			Dunleith		490	570	101	80	Samples	good	good	Dolomite	Chert	
			Decorah	Ion	570	600	21	30	Samples	good	good	Dolomite	Chert	Limestone
				Guttenbg	600	635	-9	35	Samples	good	good	Dolomite	Limestone	
		------	Plattevl		635	720	-44	85	Samples	good	good	Limestone	Dolomite	Shale
		Ancell	Glenwood	Harmony	720	726	-129	6	Samples	good	good	Shale		
			St Peter		726	772	-135	46	Samples	good	good	Sandstone		
	Canadian	Prairie	Shakopee	Willow R	772	925	-181	153	Samples	good	poor	Dolomite	Sandstone	Chert
				New Rich	925	965	-334	40	Samples	poor	good	Dolomite	Sandstone	Chert
			Oneota		965	1130	-374	165	Samples	good	fair	Dolomite	Chert	Sandstone
Cambrian	St Croix	Trempeal	Jordan		1130	1203	-539	73	Samples	fair	good	Dolomite	Sandstone	Chert
			St Lawre		1203	1367	-612	164	Samples	good	good	Dolomite	Sandstone	Chert
		Tunnel C	LoneRock		1367	1540	-776	173	Samples	good	good	Sandstone	Dolomite	Shale
		ElkMound	Wonewoc	Ironton	1460	1540	-869	80	Samples	good	good	Sandstone	Dolomite	
			Gales /E		1540	2202*	-949	662*	Samples	good		Sandstone	Dolomite	Chert
			Wonewoc	Galesvil	1540	1605	-949	65	Samples	good	good	Sandstone		
			EauClair		1605	1870	-1014	265	Samples	good	good	Sandstone	Dolomite	Chert
			Mt Simon		1870	2202*	-1279	332*	Samples	good		Sandstone		

[redacted]

THIS DATA RETRIEVED FROM THE GSB AND USGS COOPERATIVE GEOLOGIC FILE (PHONE 319-335-1575).

ATTACHMENT 1

TEGD TECHNICAL ASSESSMENT WORKSHEET

APPENDIX A.1

CHARACTERIZATION OF SITE HYDROGEOLOGY WORKSHEET

The following worksheets have been designed to assist the enforcement official in evaluating the program the owner/operator used in characterizing hydrogeologic conditions at his site. This series of worksheets has been compiled to parallel the information presented in Chapter 1 of the TEGD.

I. Review of Site Hydrogeologic Investigatory Techniques

A. Was the site investigation and/or data collection performed by a qualified professional in geology? No documentation provided (Y/N) NA

B. Did the owner/operator survey the following existing regional data:

1. U.S.G.S. Maps? Not Extensively (Y/N) N
2. Water supply well logs? (Y/N) N
3. Other (specify) ______

C. Did the owner/operator use the following direct techniques in the hydrogeologic assessment:

1. Soil borings/rock corings? (Y/N) Y
2. Materials tests (e.g., grain size analyses, standard penetration tests, etc.)? (Y/N) Y
3. Piezometer installation for water level measurements at different depths? (Y/N) Y
4. Slug tests? (Y/N) Y
5. Pump tests? (Y/N) N
6. Geochemical analyses of soil samples? (Y/N) Y
7. Other (specify) ______

). Did the owner/operator use the following indirect techniques to supplement direct techniques data:

1. Geophysical well logs? (Y/N) N
2. Tracer studies? (Y/N) N
3. Resistivity and/or electromagnetic conductance? (Y/N) N
4. Seismic survey? (Y/N) N
5. Hydraulic conductivity measurements of cores? (Y/N) N

6. Aerial photography? (Y/N) N
7. Ground penetrating radar? (Y/N) N
8. Other (specify) ________________________________

____

E. Did the owner/operator document and present the raw data from the site hydrogeologic assessment? (Y/N) Y

F. Did the owner/operator document methods (criteria) used to correlate and analyze the information? (Y/N) Y

G. Did the owner/operator prepare the following:

1. Narrative description of geology? (Y/N) Y
2. Geologic cross sections? (Y/N) Y
3. Geologic and soil maps? (Y/N) N
4. Boring/coring logs? (Y/N) Y
5. Structure contour maps of aquifer and aquitard? aquifer and aquitard not defined (Y/N) NA
6. Narrative description of ground-water flows? (Y/N) Y
7. Water table/potentiometric map? (Y/N) Y
8. Hydrologic cross sections? (Y/N) N

H. Did the owner/operator obtain a regional map of the area and delineate the facility? (Y/N) N

I. If yes, does this map illustrate:

1. Surficial geology features? (Y/N) NA
2. Streams, rivers, lakes, or wetlands near the facility? (Y/N)
3. Discharging or recharging wells near the facility? (Y/N)

J. Did the owner/operator obtain a regional hydrogeologic map? (Y/N) N

K. If yes, does this hydrogeologic map indicate:

1. Major areas of recharge/discharge? (Y/N) NA
2. Regional ground-water flow direction? (Y/N)
3. Potentiometric contours which are consistent with observed water level elevations? (Y/N)

L. Did the owner/operator prepare a facility site map? (Y/N) Y

M. If yes, does the site map show:

1. Regulated units of the facility (e.g., landfill areas, impoundments)? (Y/N) Y
2. Any seeps, springs, streams, ponds, or wetlands? (Y/N) Y

3. Location of monitoring wells, soil borings, or test pits? (Y/N) Y
4. How many regulated units does the facility have? 5
If more than one regulated unit then,
   - Does the waste management area encompass all regulated units? (Y/N) Y
   Or
   - Is a waste management area delineated for each regulated unit? (Y/N) NA

II. Characterization of Subsurface Geology of Site

A. Soil boring/test pit program:

1. Were the soil borings/test pits performed under the supervision of a qualified professional? No documentation Provided (Y/N) NA
2. Were the borings placed close enough to accurately portray stratigraphy with minimal reliance on inference? (Y/N) Y
3. If not, did the owner/operator provide documentation for selecting the spacing for borings? (Y/N) NA
4. Were the borings drilled to the depth of the first confining unit below the uppermost zone of saturation? Limestone not established as a confining unit (Y/N) NA
5. Indicate the method(s) of drilling:
   - Auger (hollow or solid stem) ✓
   - Mud rotary ____
   - Air rotary ____
   - Reverse rotary ____
   - Cable tool ____
   - Jetting ____
   - Other (specify) ____

   For some yes
   For some No
6. Were continuous sample corings taken? (Y/N) NA
7. How were the samples obtained (check method[s])
   - Split spoon ✓
   - Shelby tube, or similar ____
   - Rock coring ____
   - Ditch sampling ____
   - Other (explain) ____

8. Were the continuous sample corings logged by a qualified professional in geology? No documentation Provided (Y/N) NA
9. Does the field boring log include the following information:
   - Hole name/number? (Y/N) Y
   - Date stared and finished? (Y/N) Y
   - Geologist's name? (Y/N) N

172-437 0 - 87 - 9

- Driller's name? (Y/N) N
- Hole location (i.e., map and elevation)? (Y/N) N
- Drill rig type and bit/auger size? (Y/N) N
- Gross petrography (e.g., rock type) of each geologic unit? (Y/N) Y
- Gross mineralogy of each geologic unit? (Y/N) NA
- Gross structural interpretation of each geologic unit and structural features (e.g., fractures, gouge material, solution channels, buried streams or valleys, identification of depositional material)? (Y/N) NA (Y/N) Y
- Development of soil zones and vertical extent and description of soil type? (Y/N) Y
- Depth of water-bearing unit(s) and vertical extent of each? (Y/N) Y
- Depth and reason for termination of borehole? (Y/N) Y
- Depth and location of any contaminant encountered in borehole? (Y/N) Y
- Sample location/number? (Y/N) Y
- Percent sample recovery? (Y/N) Y
- Narrative descriptions of:
  -- Geologic observations? (Y/N) N
  -- Drilling observations? (Y/N) N

10. Were the following analytical tests performed on the core samples:
    - Mineralogy (e.g., microscopic tests and x-ray diffraction)? (Y/N) N
    - Petrographic analysis:
      - degree of crystallinity and cementation of matrix? (Y/N) NA
      - degree of sorting, size fraction (i.e, sieving), textural variations? (Y/N) N
      - rock type(s)? (Y/N) N
      - soil type? (Y/N) N
      - approximate bulk geochemistry? (Y/N) Y
      - existence of microstructures that may effect or indicate fluid flow? (Y/N) N
    - Falling head tests? (Y/N) N
    - Static head tests? (Y/N) N
    - Settling measurements? (Y/N) N
    - Centrifuge tests? (Y/N) N
    - Column drawings? (Y/N) N

B. Verification of subsurface geological data

1. Has the owner/operator used indirect geophysical methods to supplement geological conditions between borehole locations? (Y/N) N

2. Does the number of borings and analytical data indicate that the confining layer displays a low enough permeability to impede the migration of contaminants to any stratigraphically lower water-bearing units? Limestone not established as a confining layer (Y/N) NA
3. Is the confining layer laterally continuous across the entire site? (Y/N) ___
4. Did the owner/operator consider the chemical compatibility of the site-specific waste types and the geologic materials of the confining layer? (Y/N) ___
5. Did the geologic assessment address or provide means for resolution of any information gaps of geologic data? (Y/N) N
6. Does the laboratory data corroborate the field data for petrography? No laboratory data (Y/N) NA
7. Does the laboratory data corroborate the field data for mineralogy and subsurface geochemistry? (Y/N) NA

C. Presentation of geologic data

No regional cross section was given.

1. Did the owner/operator present an adequate number of geologic cross sections of the site? (Y/N) N
2. Do each of these cross sections:

   What is below the limestone?

   - identify the types and characteristics of the geologic materials present? (Y/N) Y
   - define the contact zones between different geologic materials? (Y/N) Y
   - note the zones of high permeability or fracture? (Y/N) Y
   - give detailed borehole information including: (Y/N) Y
     - -- location of borehole? (Y/N) Y
     - -- depth of termination? (Y/N) Y
     - -- location of screen (if applicable)? (Y/N) Y
     - -- depth of zone of saturation? (Y/N) N
     - -- depiction of any geophysical logs?
3. Did the owner/operator provide a topographic map which was constructed by a licensed surveyor? (Y/N) N
4. Does the topographic map provide: (Y/N) NA
   - contours at a maximum interval of two-feet?
   - locations and illustrations of man-made features (e.g., parking lots, factory buildings, drainage ditches, storm drains, pipelines, etc.)? (Y/N) ___
   - descriptions of nearby water bodies? (Y/N) ___
   - descriptions of off-site wells? (Y/N) ___
   - site boundaries? (Y/N) ___
   - individual RCRA units? (Y/N) ___
   - delineation of the waste management area(s)? (Y/N) ___
   - solid waste management areas? (Y/N) ___
   - well and boring locations? (Y/N) ___

5. Did the owner/operator provide an aerial photograph depicting the site and adjacent off-site features? (Y/N) N

6. Does the photograph clearly show surface water bodies, adjacent municipalities, and residences and are these clearly labelled? (Y/N) NA

III. Identification of Ground-Water Flow Paths

A. Ground-water flow direction

1. Was the well casing height measured by a licensed surveyor to the nearest 0.01 feet? (Y/N) N
2. Were the well water level measurements taken within a 24 hour period? (Y/N) Y
3. Were the well water level measurements taken to the nearest 0.01 feet? (Y/N) N
4. Were the well water levels allowed to stabilize after construction and development for a minimum of 24 hours prior to measurements? (Y/N) Y
5. Was the water level information obtained from (check appropriate one):
   - multiple piezometers placement in single boreholes? Not clearly documented Na
   - vertically nested piezometers in closely spaced separate boreholes?
6. Did the owner/operator provide construction details for the piezometers? (Y/N) Y
7. How were the static water levels measured (check method(s).
   - Electric water sounder ____
   - Wetted tape ____
   - Air line ____
   - Other (explain) ____ Acoustic Sounder
8. Was the well water level measured in wells drilled to an equivalent depth below the saturated zone, or screened at an equivalent depth below the saturated zone? wells No Piezometers Yes (Y/N) NA
9. Has the owner/operator provided a site water table (potentiometric) contour map? If yes, (Y/N) Y
   - Do the potentiometric contours appear logical based on topography and presented data? (Consult water level data) (Y/N) Y
   - Are ground-water flowlines indicated? 2 map NO 1 map Yes (Y/N) NA
   - Are static water levels shown? (Y/N) N
   - Can hydraulic gradients be estimated? (Y/N) Y

10. Did the owner/operator develop two, or more, hydrologic cross sections of the vertical flow component across the site? (Y/N) N
11. Do the owner/operator's flow nets include:
    - piezometer locations? (Y/N) NA
    - depth of screening? (Y/N)
    - width of screening? (Y/N)

B. Seasonal and temporal fluctuations in ground-water level

1. Do fluctuations in static water levels occur? (Y/N) Y
    - If yes, are the fluctuations caused by any of the following:
      -- Off-site well pumping (Y/N) NA No Explanation Provided
      -- Tidal processes or other intermittent natural variations (e.g., river stage, etc.) (Y/N)
      -- On-site well pumping (Y/N)
      -- Off-site, on-site construction or changing land use patterns (Y/N)
      -- Deep well injection (Y/N)
      -- Waste disposal practices (Y/N)
      -- Seasonal variations (Y/N)
      -- Other (specify) ______________________
2. Has the owner/operator documented the source and patterns that contribute to or affect the ground-water flow patterns below the waste management area? Documentation Inadequate (Y/N) N
3. Do the water level fluctuations alter the general ground-water gradients and flow directions? (Y/N) Y
4. Based on water level data, do any head differentials occur that may indicate a vertical flow component in the saturated zone? (Y/N) Y
5. Did the owner/operator implement means for gauging long term effects on water movement that may result from on-site or off-site construction or changes in land-use patterns? (Y/N) N

C. Hydraulic conductivity

1. How were hydraulic conductivities of the subsurface materials determined?
    - Single-well tests (slug tests)? (Y/N) Y
    - Multiple-well tests (pump tests)? (Y/N) N
2. If single-well tests were conducted, was it done by:
    - Adding or removing a known volume of water? (Y/N) Y
      or
    - Pressurizing well casing (Y/N) N

3. If single well tests were conducted in a highly permeable formation, were pressure transducers and high-speed recording equipment used to record the rapidly changing water levels? Procedure Not well documented (Y/N) NA
4. Since single well tests only measure hydraulic conductivity in a limited area, were enough tests run to ensure a representative measure of conductivity in each hydrogeologic unit? (Y/N) N
5. Is the owner/operator's slug or pump test data consistent with existing geologic information (e.g., boring logs)? (Y/N) Y
6. Were other hydraulic conductivity properties determined? (Y/N) N
7. If yes, provide any of the following data, if available:
   - Transmissivity NA
   - Storage coefficient
   - Leakage
   - Permeability
   - Porosity
   - Specific capacity
   - Other (specify) ____________

D. Identification of the uppermost aquifer

The uppermost aquifer has been poorly defined but its extent is defined

1. Has the extent of the uppermost aquifer in the facility area been defined? If yes, (Y/N) NA
   - Are soil boring/test pit logs included? (Y/N) Y
   - Are geologic cross-sections included? (Y/N) Y
2. Is there evidence of confining (competent, unfractured, continuous, and low permeability) layers beneath the site? (Y/N) NA
   - If yes, was continuity demonstrated through the evidence of lack of drawdown in the upper well when separate, closely-spaced wells (one screened at the uppermost part of the water table, and the other screened on the lower side of the confining layer) are pumped simultaneously? The uppermost aquifer and possible confining layers are poorly defined (Y/N) ____
3. Was hydraulic conductivity of the confining unit determined by direct field measurements to be of sufficient low permeability to prevent passage of contaminants to saturated, stratigraphically lower units? (Y/N) ____
4. Does potential for other hydraulic interconnection exist (e.g., lateral incontinuity between geologic units, facies changes, fracture zones, cross cutting structures, or chemical corrosion/alteration of geologic units by leachate)? (Y/N) ____

IV. Conclusions

A. Subsurface geology

Except for Limestone

1. Has sufficient data been collected to adequately define petrography and petrographic variation? (Y/N) Y
2. Has the subsurface geochemistry been adequately defined? (Y/N) Y
3. Was the boring/coring program adequate to define subsurface geologic variation? (Y/N) Y
4. Was the owner/operator's narrative description complete and accurate in its interpretation of the data? (Y/N) Y
5. Does the geologic assessment address or provide means to resolve any information gaps? (Y/N) N

B. Ground-water flow paths

1. Did the owner/operator adequately establish the horizontal and vertical components of ground-water flow? (Y/N) N
2. Were appropriate methods used to establish ground-water flow paths? (Y/N) Y
3. Did the owner/operator provide accurate documentation? (Y/N) N
4. Are the potentiometric surface measurements valid? (Y/N) Y
5. Did the owner/operator adequately consider the seasonal and temporal effects on the ground-water? (Y/N) Y
6. Were sufficient hydraulic conductivity tests performed to document lateral and vertical variation in hydraulic conductivity in the entire hydrogeologic subsurface below the site? (Y/N) N

C. Uppermost aquifer

1. Did the owner/operator adequately define the uppermost aquifer? (Y/N) NA

uppermost aquifer and confining layer were not defined

APPENDIX A.2

PLACEMENT OF DETECTION MONITORING WELLS WORKSHEET

The following worksheets are designed to assist the enforcement officer's evaluation of an owner/operator's approach for selecting the number, location, and depth of all detection phase monitoring wells. This series of worksheets has been compiled to closely track the information presented in Chapter 2 of the TEGD. The guide for the evaluation of an owner/operator's placement of monitoring wells is highly dependent upon a thorough characterization of the site hydrogeology as described in Chapter 1 of the TEGD and Appendix A.1 worksheets.

I. Placement of Downgradient Detection Monitoring Wells

A. Are the ground-water monitoring wells or clusters located immediately adjacent to the waste management area? (Y/N) Y

B. Does the owner/operator provide a rationale for the location of each monitoring well or cluster? (Y/N) N

C. Does the owner/operator provide an explanation for the density of the ground-water monitoring wells? (Y/N) N

D. Has the owner/operator identified the screen length(s) of each monitoring well or cluster? (Y/N) Y

E. What length screens has the owner/operator employed in the ground-water monitoring wells on site?

MW 13 10.0
MW 20 5.0 ft
MW 21 5.0 ft

F. Does the owner/operator provide an explanation for the screen lengths of each monitoring well or cluster? (Y/N) N

G. Do the actual locations of monitoring wells or clusters correspond to those identified by the owner/operator? (Y/N) N

II. Placement of Upgradient Monitoring Wells

A. Has the owner/operator documented the location of each upgradient monitoring well or cluster? (Y/N) Y

B. Does the owner/operator provide an explanation for the location(s) of the upgradient monitoring wells? (Y/N) N

C. What length screens has the owner/operator employed in the background monitoring well(s)?
MW-22 5.0 ft

D. Does the owner/operator provide an explanation for the screen length(s) chosen? (Y/N) N

E. Are the upgraident monitoring wells installed in the same portion of the uppermost aquifer as the downgradient monitoring wells? uppermost aquifer is not defined (Y/N) NA

F. Does the actual location of each background monitoring well or cluster correspond to that identified by the owner/operator? (Y/N) N

III. Conclusions

A. Downgradient Wells

Do the location, number, and screen lengths of the ground-water monitoring wells or clusters in the detection monitoring system allow for the immediate detection of a release of hazardous waste or constituents from the hazardous waste management area? Yes if there are upward gradients between the limestone and soil. (Y/N) NA

B. Upgradient Wells

Do the location and screen lengths of the upgradient (background) ground-water monitoring wells ensure the capability of collecting ground-water samples representatiave of upgradient (background) ground-water quality including any ambient heterogeneous chemical characteristics? same as above (Y/N) NA

APPENDIX A.3

MONITORING WELL DESIGN AND CONSTRUCTION WORKSHEET

The following worksheets have been designed to assist the enforcement officer in evaluating the techniques used by an owner/operator for designing and constructing monitoring wells. This series of worksheets has been compiled to parallel the information presented in Chapter 3 of the TEGD.

I. Monitoring Well Design

A. Complete the attached well construction summary sheet for the monitoring well unless similar documentation is already available from the owner/operator. Include the locations where the well intercepts changes in geological formation.

II. Drilling Methods

A. What drilling method was used for the well?

- Hollow-stem auger ✓
- Solid-stem auger ____
- Cable tool ____
- Air rotary ____
- Water rotary ____
- Mud rotary ____
- Reverse rotary ____
- Jetting ____
- Air drill with casing hammer ____
- Other (specify) ____

B. Were any drilling fluids (including water) or additives used during drilling? (Y/N) N
If yes, specify
Type of drilling fluid ____
Source of water used ____
Foam ____
Polymers ____
Other ____

C. Was the drilling fluid, or additive, analyzed? (Y/N) NA

D. Was the drilling equipment steam-cleaned prior to drilling the well? (Y/N) Y

PROJECT Surface Impoundment Closure	WELL NO. 13
SITE Collis Inc.	AQUIFIER
COORDINATES	
DATE COMPLETED 4-24-84	
SUPERVISED BY	

GROUND ELEVATION

GENERALIZED STRATIGRAPHY

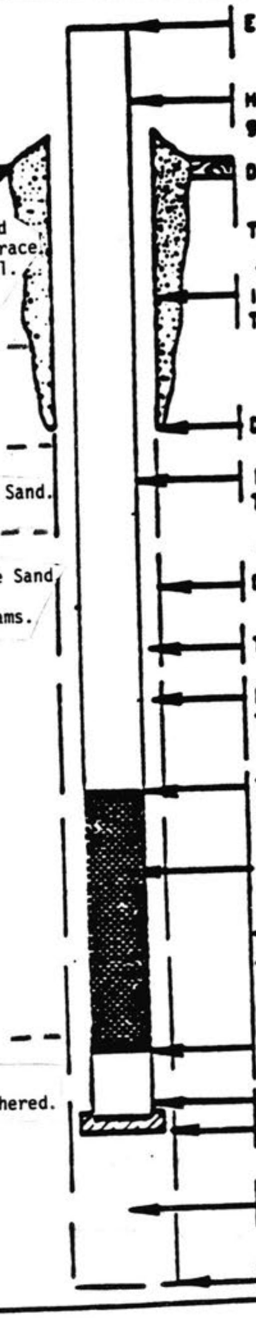
FILL:
Concrete, cinders, and silt - little clay, trace sand, roots and gravel. Dark brown.

FILL:
Sandy Clayey Silt
Dark Brown.

FILL:
Silty Clay - little Sand.
Brown.

SOIL:
Clayey Silt - little Sand
Gray to Red-Gray.
Occassional sand seams.

LIMESTONE:
Brown, highly weathered.



Elevation of reference point	591.40
Height of reference point above ground surface	34.5"
Depth of surface seal	1.2'
Type of surface seal: concrete	
I.D. of surface casing	None
Type of surface casing: None	
Depth of surface casing	NA
I.D. of riser pipe	2"
Type of riser pipe: PVC	
Diameter of borehole	8"
Type of filler: bentonite	
Elevation / depth of top of seal	587.1
Type of seal: bentonite	
Type of gravel pack silica sand	
Elev./depth of top of gravel pack	579.3'
Elevation / depth of top of screen	578.3'
Description of screen PVC .010 slot size	
I.D. of screen section	2"
Elevation / depth of bottom of screen	568.3'
Elev./depth of bottom of gravel pack	567.8'
Elev./depth of bottom of plugged blank section	NA
Type of filler below plugged section None	
Elevation of bottom of borehole	567.7'

Well Construction Summary.

PROJECT Surface Impoundment Closure

SITE Collis Inc.

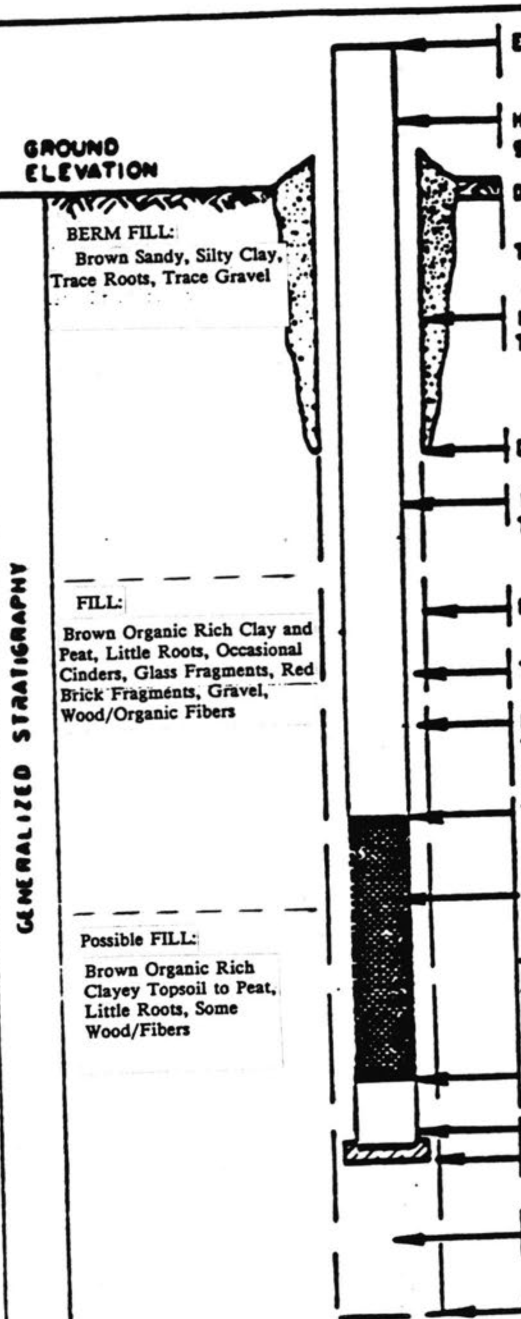
COORDINATES

DATE COMPLETED 2-2-88

SUPERVISED BY

WELL NO. 20

AQUIFIER



Elevation of reference point	590.07
Height of reference point above ground surface	26"
Depth of surface seal	?
Type of surface seal: concrete	
I.D. of surface casing	None
Type of surface casing: None	
Depth of surface casing	NA
I.D. of riser pipe	2"
Type of riser pipe: PVC	
Diameter of borehole	?
Type of filler: cement-bentonite	
Elevation / depth of top of seal	?
Type of seal: bentonite	
Type of gravel pack silica sand	
Elev./depth of top of gravel pack	?
Elevation / depth of top of screen	584'
Description of screen PVC .010 slot size	
I.D. of screen section	2"
Elevation / depth of bottom of screen	579'
Elev./depth of bottom of gravel pack	579'
Elev./depth of bottom of plugged blank section	NA
Type of filler below plugged section NA	
Elevation of bottom of borehole	579'

Well Construction Summary.

PROJECT Surface Impoundment Closure

SITE Collis Inc.

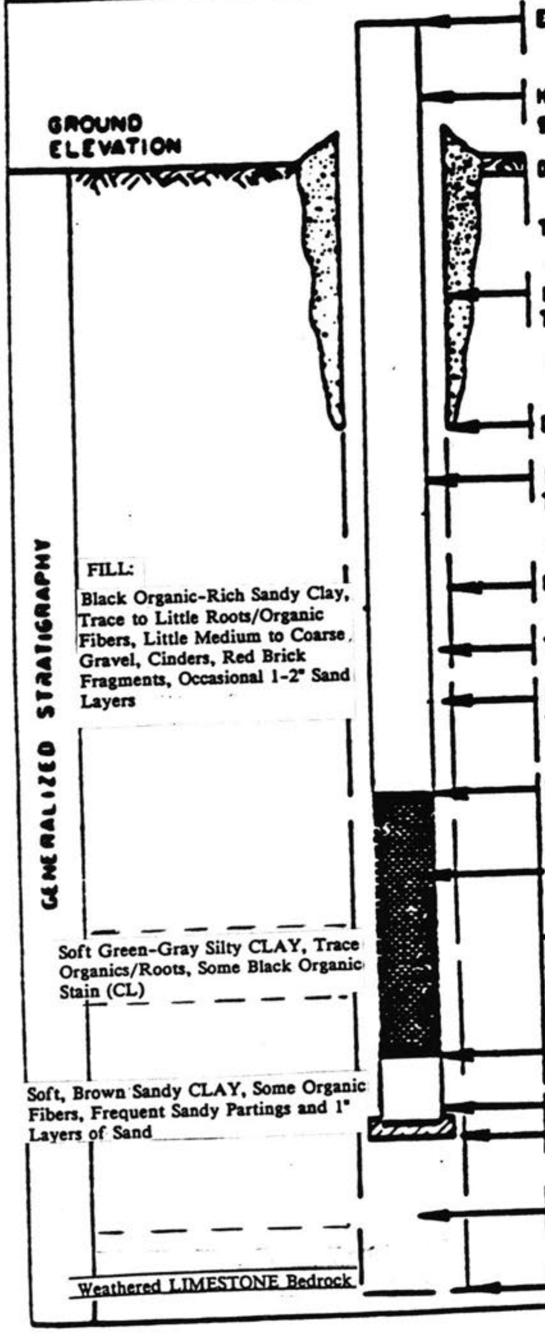
COORDINATES

DATE COMPLETED 2-4-88

SUPERVISED BY

WELL NO. 21

AQUIFIER



Elevation of reference point 588.94

Height of reference point above ground surface 23"

Depth of surface seal ?

Type of surface seal: concrete

I.D. of surface casing None

Type of surface casing: None

Depth of surface casing NA

I.D. of riser pipe 2"

Type of riser pipe: PVC

Diameter of borehole ?

Type of filler: cement-bentonite

Elevation / depth of top of seal ?

Type of seal: bentonite

Type of gravel pack silica Sand

Elev./depth of top of gravel pack ?

Elevation / depth of top of screen 584.1'

Description of screen PVC .010 slot size

I.D. of screen section 2"

Elevation / depth of bottom of screen 579.1'

Elev./depth of bottom of gravel pack NA

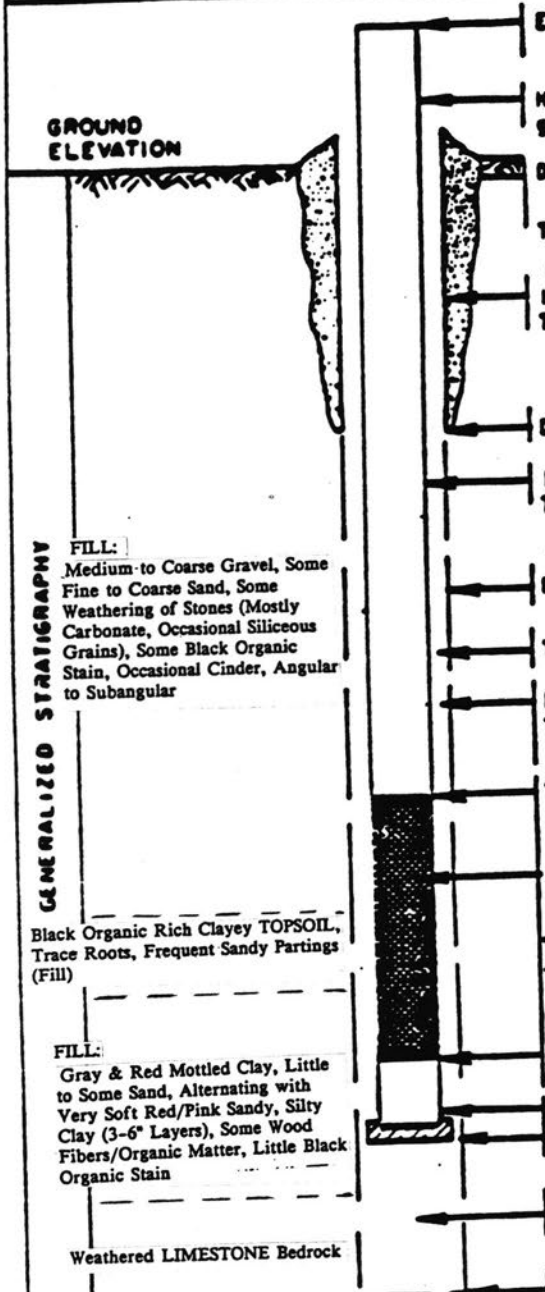
Elev./depth of bottom of plugged blank section NA

Type of filler below plugged section NA

Elevation of bottom of borehole 577.6'

Well Construction Summary.

PROJECT: Surface Impoundment Closure	WELL NO. 22
SITE: Collis Inc.	AQUIFIER
COORDINATES	
DATE COMPLETED: 2-2-88	
SUPERVISED BY	



Elevation of reference point	590.24
Height of reference point above ground surface	17"
Depth of surface seal	?
Type of surface seal: concrete	
I.D. of surface casing	None
Type of surface casing: None	
Depth of surface casing	NA
I.D. of riser pipe	2"
Type of riser pipe: PVC	
Diameter of borehole	?
Type of filler: cement-bentonite	
Elevation / depth of top of seal	?
Type of seal: bentonite	
Type of gravel pack: cilica sand	
Elev./depth of top of gravel pack	?
Elevation / depth of top of screen	586.8'
Description of screen: PVC .010 slot size	
I.D. of screen section	2"
Elevation / depth of bottom of screen	581.8'
Elev./depth of bottom of gravel pack	NA
Elev./depth of bottom of plugged blank section	NA
Type of filler below plugged section: NA	
Elevation of bottom of borehole	580.3'

Well Construction Summary.

E. Was compressed air used during drilling? (Y/N) N
   1. If yes, was the air treated to remove oil (e.g., filtered)? (Y/N) NA

F. Did the owner/operator document procedure for establishing the potentiometric surface? (Y/N) Y
   1. If yes, how was the location established?
   Surveyor established horizontal and vertical location of the wells.

G. Formation samples
   1. Were continuous formation sample cores collected initially during drilling? (Y/N) Y
   2. How were the samples obtained?
      - Split spoon ✓
      - Shelby tube ____
      - Core drill ____
      - Other (specify) ____
   3. Indicate the intervals at which formation samples were collected 2.5'
   4. Identify if any physical and/or chemical tests were performed on the formation samples (specify) None

III. Monitoring Well Construction Materials

List of Potential Construction Materials for the Saturated Zone

1. Stainless steel (316, 304, 2205)
2. Fluorocarbon resins (specify) ____
3. Other (specify) PVC

Teflon

A. Identify construction materials (by number) and diameters (ID/OD)

	Material	Diameter (ID/OD)
1. Primary Casing	PVC	2"
2. Secondary or outside casing (double construction)	NA	NA
3. Screen	PVC	2"

B. How are the sections of casing and screen connected?
- Pipe sections threaded ✓
- Couplings (friction) with adhesive or solvent ____
- Couplings (friction) with retainer screws ____
- Other (specify) ____ Don't know

C. Were the materials steam-cleaned prior to installation? (Y/N) NA
Other cleaning methods (specify) ____

IV. Well Intake Design and Well Development

A. Was a well intake screen installed? (Y/N) Y
1. What is the length of the screen for the well?
____
2. Is the screen manufactured? (Y/N) Y

B. Was a filter pack installed? (Y/N) Y
1. Wase the material used to construct the filter pack chemically inert? Specify the material ____ silica sand (Y/N) Y
2. Has a turbidity measurement of the well water ever been made? (Y/N) Y

C. Well development
1. What technique was used for well development?
- Surge block ____
- Bailer ✓
- Air surging ____
- Water pumping ____
- Other (specify) ____

V. Annular Space Seals

A. Is the annular space in the saturated zone directly above the filter pack filled with?
- Sodium bentonite (specify type and grit) bentonite pellets or granular bentonite
- Cement (specify neat or concrete) ____
- Other (specify) ____

1. Was the seal installed by?
- Dropping material down the hole and tamping ____
- Dropping material down the inside of hollow-stem auger ✓ by handfuls
- Tremie pipe method ____
- Other (specify) ____

B. Was a different seal used in the unsaturated zone? (Y/N) Y
If yes,
1. Was this seal made with?
   - Sodium bentonite (specify type and grit) ____________
   - Cement (specify neat or concrete) ____________
   - Other (specify) 10% bentonite/cement
2. Was this seal installed by?
   - Dropping material down the hole and tamping ________
   - Dropping material down the inside of hollow-stem auger ________
   - Tremie pipe method ✓
   - Other (specify) ____________

C. Is the upper portion of the borehole sealed with a concrete cap to prevent infiltration from the surface? (Y/N) Y

D. Is the well fitted with an above-ground protective device? (Y/N) Y

E. Has the protective cover been installed with locks to prevent tampering? (Y/N) Y

VI. Field Tests/Field Demonstration

A. Do field measurements of the following agree with reported data:
1. Casing diameter? (Y/N) Y
2. Well depth? (Y/N) Y
3. Water level elevation? (Y/N) Y

B. If the existing well is being field demonstrated, complete Questions 1 through 7.
1. Is the location of the demonstration well hydraulically equivalent to the existing well? (Y/N) NA
2. Was the demonstration well installed using EPA-approved methods and materials? (Y/N) ____
3. How were the wells evacuated (e.g., bailer or bladder pump)?
   existing well: ____________
   demonstration well: ____________
4. Were the wells sampled concurrently? (Y/N) ____
5. Were the wells each sampled using the appropriate EPA methodology? (Y/N) ____

6. What parameters were the ground water samples analyzed for?

____

____

____

____

____

7. Are the values for these parameters equivalent for each well (i.e., within the acceptable standard deviations)? (Y/N) NA

VII. Conclusions

A. Do the design and construction of the owner/operator's ground-water monitoring wells permit depth discrete ground-water samples to be taken? (Y/N) Y

B. Are the samples representative of ground-water quality? (Y/N) Y

C. Are the ground-water monitoring wells structurally stable? (Y/N) Y

D. Does the ground-water monitoring well's design and construction permit an accurate assessment of aquifer characteristics? (Y/N) Y

APPENDIX A.4

SAMPLING AND ANALYSIS WORKSHEET

The following worksheets have been designed to assist the enforcement officer in evaluating the techniques an owner/operator uses to collect and analyze ground-water samples. This series of worksheets has been compiled based on the information provided in Chapter 4 of the TEGD.

I. Review of Sample Collection Procedures

A. Measurement of well depths elevation:

1. Are measurements of both depth to standing water and depth to the bottom of the well made? Yes standing water No bottom of well (Y/N) ___
2. Are measurements taken to the nearest centimeter or 0.01 foot? Not mentioned (Y/N) NA
3. What device is used?
   No Information
4. Is there a reference point(s) established by a licensed surveyor? Well is surveyed but no reference mark is mentioned. (Y/N) NA

B. Detection of immiscible layers:

1. Are procedures used which will detect light phase immiscible layers? (Y/N) N
2. Are procedures used which will detect dense phase immiscible layers? (Y/N) N

C. Sampling of immiscible layers:

1. Are the immiscible layers sampled separately prior to well evacuation? (Y/N) NA
2. Do the procedures used minimize mixing with water soluble phase? (Y/N) NA

D. Well evacuation:

1. Are low yielding wells evacuated to dryness? (Y/N) Y
2. Are high yielding wells evacuated so that at least three casing volumes are removed? (Y/N) Y
3. What device is used to evacuate the wells?
   Bailer or Pump
4. If any problems are encountered (e.g., equipment malfunction) are they noted in a field logbook? (Y/N) Y

E. Sample withdrawal:

1. For low-yielding wells, are first samples tested for pH, temperature, and specific conductance after the well recovers? (Y/N) N

2. Are samples collected and containerized in order of the parameters volatilization sensitivity? (Y/N) N
3. For higher-yielding wells, are samples retested for pH, temperature, and specific conductance to determine purging efficiency? (Y/N) Y
4. Are samples withdrawn with either fluorocarbon resins or stainless steel (304, 316, 2205) sampling devices? Not mentioned (Y/N) NA
5. Are sampling devices either bottom valve bailers or positive gas displacement bladder pumps? Not mentioned (Y/N) NA
6. If bailers are used, is fluorocarbon resin-coated wire, single strand stainless steel wire, or monofilament used to raise and lower the bailer? (Y/N)___
7. If bladder pumps are used, are they operated in a continuous manner to prevent aeration of the sample? (Y/N)___
8. If bailers are used, are they lowered slowly to prevent degassing of the water? (Y/N)___
9. If bailers are used, are the contents transferred to the sample container in a way that will minimize agitation and aeration? (Y/N)___
10. Is care taken to avoid placing clean sampling equipment on the ground or other contaminated surfaces prior to insertion into the well? (Y/N)___
11. If dedicated sampling equipment is not used, is equipment disassembled and thoroughly cleaned between samples? (Y/N)___
12. If samples are for inorganic analysis, does the cleaning procedure include the following sequential steps:
    a. Nonphosphate detergent wash? (Y/N) Y
    b. Dilute acid rinse (HNO_3 or HCl)? (Y/N) N
    c. Tap water rinse? (Y/N) Y
    d. Type II reagent grade water? (Y/N) Y
13. If samples are for organic analysis, does the cleaning procedure include the following sequential steps:
    a. Nonphosphate detergent wash? (Y/N) Y
    b. Tap water rinse? (Y/N) Y
    c. Distilled/deionized water rinse? (Y/N) Y
    d. Acetone rinse? (Y/N) N
    e. Pesticide-grade hexane rinse? (Y/N) N
14. Is sampling equipment thoroughly dry before use? Not mentioned (Y/N) NA
15. Are equipment blanks taken to ensure that sample cross-contamination has not occurred? (Y/N) Y
16. If volatile samples are taken with a positive gas displacement bladder pump, are pumping rates below 100 ml/min? (Y/N) NA

F. In-situ or field analyses:
   1. Are the following labile (chemically unstable) parameters determined in the field:
      a. pH? (Y/N) Y
      b. Temperature? (Y/N) Y
      c. Specific conductivity? (Y/N) Y
      d. Redox potential? (Y/N) N
      e. Chlorine? (Y/N) N
      f. Dissolved oxygen? (Y/N) N
      g. Turbidity? (Y/N) N
      h. Other (specify) ________ (Y/N) N
   2. For in-situ determinations, are they made after well evacuation and sample removal? (Y/N) NA
   3. If sample is withdrawn from the well, is parameter measured from a split portion? (Y/N) Y
   4. Is monitoring equipment calibrated according to manufacturers' specifications and consistent with SW-846? (Y/N) Y
   5. Is the date, procedure, and maintenance for equipment calibration documented in the field logbook? (Y/N) Y

II. Review of Sample Preservation and Handling Procedures

A. Sample containers:
   1. Are samples transferred from the sampling device directly to their compatible containers? No information on metals (Y/N) Y
   2. Are sample containers for metals (inorganics) analyses polyethylene with polypropylene caps? (Y/N) Y
   3. Are sample containers for organics analysis glass bottles with fluorocarbon resin-lined caps? Yes TOX No TOC (Y/N) ____
   4. If glass bottles are used for metals samples are the caps fluorocarbon resin-lined? (Y/N) NA
   5. Are the sample containers for metal analyses cleaned using these sequential steps? No Information. Probably Pre-cleaned containers.
      a. Nonphosphate detergent wash? (Y/N) NA
      b. 1:1 nitric acid rinse? (Y/N) ____
      c. Tap water rinse? (Y/N) ____
      d. 1:1 hydrochloric acid rinse? (Y/N) ____
      e. Tap water rinse? (Y/N) ____
      f. Type II reagent grade water rinse? (Y/N) ____
   6. Are the sample containers for organic analyses cleaned using these sequential steps?
      a. Nonphosphate detergent/hot water wash? (Y/N) ____
      b. Tap water rinse? (Y/N) ____
      c. Distilled/deionized water rinse? (Y/N) ____
      d. Acetone rinse? (Y/N) ____
      e. Pesticide-grade hexane rinse? (Y/N) ____

7. Are trip blanks used for each sample container type to verify cleanliness? (Y/N) N

B. Sample preservation procedures:
   1. Are samples for the following analyses cooled to 4°C:
      a. TOC? (Y/N) Y
      b. TOX? (Y/N) Y
      c. Chloride? (Y/N) N
      d. Phenols? (Y/N) Y
      e. Sulfate? (Y/N) Y
      f. Nitrate? (Y/N) NA
      g. Pesticides/Herbicides? (Y/N) |
      h. Coliform bacteria? (Y/N) |
      i. Cyanide? (Y/N) |
      j. Oil and grease? (Y/N) |
      k. Volatile, semi-volatile, and nonvolatile organics? (Y/N) |
   2. Are samples for the following analyses field acidified to pH <2 with HNO_3:
      a. Iron? (Y/N) Y
      b. Manganese? (Y/N) Y
      c. Sodium? (Y/N) Y
      d. Total metals? (Y/N) NA
      e. Dissolved metals? (Y/N) |
      f. Radium? (Y/N) |
      g. Gross alpha? (Y/N) |
      h. Gross beta? (Y/N) |
   3. Are samples for the following analyses field acidified to pH <2 with H_2SO_4:
      a. Phenols? to pH < 4 (Y/N) Y
      b. Oil and grease? (Y/N) NA
   4. Is the sample for TOC analyses field acidified to pH <2 with H_2SO_4 or HCl? (Y/N) Y
   5. Is the sample for TOX analysis preserved with 1 ml of 1.1 M sodium sulfite? (Y/N) N
   6. Is the sample for cyanide analysis preserved with NaOH to pH >12? (Y/N) NA
   7. Are pesticides pH adjusted to between 6 and 8 with NaOH or H_2SO_4? (Y/N) NA

C. Special handling considerations:
   1. Are organic samples handled without filtering? (Y/N) Y
   2. Are samples for volatile organics transferred to the appropriate vials to eliminate headspace over the sample? TOX Yes TOC NO (Y/N) ____
   3. Are samples for metal analysis split into two portions? (Y/N) N
   4. Is the sample for dissolved metals filtered through a 0.45 micron filter? (Y/N) Y

5. Is the second portion not filtered and analyzed for total metals? (Y/N) NA
6. Is one equipment blank prepared each day of ground-water sampling? 1 blank per 10 samples (Y/N)___

III. Review of Analytical Procedures

A. Laboratory analysis procedures: No Information provided
1. Are all samples analyzed using an EPA-approved method (SW-846)? (Y/N) NA
2. Are appropriate QA/QC measures used in laboratory analysis (e.g., blanks, spikes, standards)? (Y/N)___
3. Are detection limits and percent recovery (if applicable) provided for each parameter? (Y/N)___
4. If a new analytical method or laboratory is used, are split samples run for comparison purposes? (Y/N)___
5. Are samples analyzed within specified holding times? (Y/N)___

B. Laboratory logbook:
1. Is a laboratory logbook maintained? (Y/N)___
2. Are experimental conditions (e.g., temperature, humidity, etc.) noted? (Y/N)___
3. If a sample for volatile analysis is received with headspace, is this noted? (Y/N)___
4. Are the results for all QC samples identified? (Y/N)___
5. Is the time, date, and name of person noted for each processing step? (Y/N)___

IV. Review of Chain-of-Custody Procedures

A. Sample labels:
1. Are sample labels used? (Y/N) Y
2. Do they provide the following information:
   a. Sample identification number? (Y/N) Y
   b. Name of collector? (Y/N) Y
   c. Date and time of collection? No Time (Y/N) Y
   d. Place of collection? (Y/N) Y
   e. Parameter(s) requested: (Y/N) Y
3. Do they remain legible even if wet? (Y/N) NA

B. Sample seals:
1. Are sample seals placed on those containers to ensure the samples are not altered? (Y/N) N

C. Field logbook:
   1. Is a field logbook maintained? (Y/N) Y
   2. Does it document the following:
      a. Purpose of sampling (e.g., detection or assessment)? (Y/N) NA

         What will be contained is not spelled out

      b. Identification of well? (Y/N) ___
      c. Total depth of each well? (Y/N) ___
      d. Static water level depth and measurement technique? (Y/N) ___
      e. Presence of immiscible layers and detection method? (Y/N) ___
      f. Collection method for immiscible layers and sample identification numbers? (Y/N) ___
      g. Well yield - high or low? (Y/N) ___
      h. Purge volume and pumping rate? (Y/N) ___
      i. Time well purged? (Y/N) ___
      j. Well evacuation procedures? (Y/N) ___
      k. Sample withdrawal procedure? (Y/N) ___
      l. Date and time of collection? (Y/N) ___
      m. Well sampling sequence? (Y/N) ___
      n. Types of sample containers and sample identification numbers? (Y/N) ___
      o. Preservative(s) used? (Y/N) ___
      p. Parameters requested? (Y/N) ___
      q. Field analysis data and method(s)? (Y/N) ___
      r. Sample distribution and transporter? (Y/N) ___
      s. Field observations? (Y/N) ___
         - Unusual well recharge rates? (Y/N) ___
         - Equipment malfunction(s)? (Y/N) ___
         - Possible sample contamination? (Y/N) ___
         - Sampling rate? (Y/N) ___
      t. Field team members? (Y/N) ___
      U. Climatic conditions and air temperature? (Y/N) ___

D. Chain-of-custody record:
   1. Is a chain-of-custody record included with each sample? (Y/N) Y
   2. Does it document the following:
      a. Sample number? (Y/N) Y
      b. Signature of collector? (Y/N) Y
      c. Date and time of collection? (Y/N) Y
      d. Sample type? (Y/N) Y
      e. Identification of well? (Y/N) Y
      f. Number of containers? (Y/N) Y
      g. Parameters requested? (Y/N) Y
      h. Signatures of persons involved in the chain-of-possession? (Y/N) Y
      i. Inclusive dates of possession? (Y/N) Y

E. Sample analysis request sheet:
   1. Does a sample analysis request sheet accompany each sample? (Y/N) N
   2. Does the request sheet document the following:
      a. Name of person receiving the sample? (Y/N) NA
      b. Date of sample receipt? (Y/N)
      c. Laboratory sample number (if different than field number)? (Y/N)
      d. Analyses to be performed? (Y/N)

F. Laboratory logbook:
   1. Is a laboratory logbook maintained? No information Provided (Y/N) NA
   2. If so, does it document the following:
      a. Sample preparation techniques (e.g., extraction)? (Y/N)
      b. Instrumental methods? (Y/N)
      c. Experimental conditions? (Y/N)

V. Review of Quality Assurance/Quality Control

A. Is the validity and reliability of the laboratory and field generated data ensured by a QA/QC program? No Information (Y/N) NA

B. Does the QA/QC program include:
   1. Documentation of any deviations from approved procedures? (Y/N) Y
   2. Collection and analysis of trip blanks and equipment blanks? (Y/N) Y
   3. Documentation of analytical results for:
      a. Laboratory blanks? (Y/N) NA
      b. Standards? (Y/N)
      c. Duplicates? (Y/N)
      d. Spiked samples? (Y/N)

C. Are approved statistical methods used? (Y/N) N

D. Are QC samples used to correct data? (Y/N) N

E. Are all data critically examined to ensure it has been properly calculated and reported? No Information (Y/N) NA

VI. Review of Indicators of Data Quality

A. Reporting of low and zero concentration values:
   1. Do specific concentration values accompanying measurements reported as less than a limit of detection? (Y/N) N
   2. Is the magnitude of detection limits consistent throughout the data set for each parameter? (Y/N) NA

3. Have techniques described in Appendix B of 40 CFR §136 been used to determine the detection limits? No Information (Y/N) NA
4. Has the method for using less than detection limit data in presentations and statistical analysis been documented? (Y/N)

B. Significant digits:
   1. Are constituent concentrations reported with a consistent number of significant digits? (Y/N) Y
   2. Are all indicator parameters reported with at least three significant digits? (Y/N) N

C. Missing data values:
   1. Is the monitoring data set complete? Yes According to Sampling plan No According to 40 CFR 265 (Y/N) NA
   2. Are t-test comparisons between upgradient and downgradient wells attempted despite missing data provided that:
      a. At least one upgradient and one downgradient well were sampled? No statistics presented (Y/N) NA
      b. In the case of a missing quarterly sampling set, values are assigned by averaging corresponding values for the other three quarters? (Y/N)
      c. In the case of missing replicate values from a sampling event, values are assigned by averaging the replicate(s) which are available for that sampling event? (Y/N)

D. Outliers:
   1. Have extreme values (outliers) of constituent concentrations deleted or otherwise modified because of:
      a. Incorrect transcription? (Y/N)
      b. Methodological problems or an unnatural catastrophic event? (Y/N)
      c. Are these above occurrences fully documented? (Y/N)
   2. Are true but extreme values unaltered and incorporated in the analysis? (Y/N)

E. Units of measure:
   1. Are all units of measure reported accurately? (Y/N)
   2. Are the units of measure for a given chemical parameter used consistently throughout the report? (Y/N) Y

3. Do the reporting formats clearly indicate consistent units of measure throughout so that no ambiguity exists (i.e., do the units accompany each parameter instead of a statement, "all values are ppm unless otherwise stated")?

(Y/N) N

VII. Conclusions

A. Does the sampling and analysis plan permit the owner/operator to detect and, where applicable, assess the nature and extent of a release of hazardous constituents to ground water from the monitored hazardous waste management facility?

(Y/N) Y

Except that 40 CFR Part 265 App. III parameters are not analyzed for.

APPENDIX A.5

PRESENTING DETECTION MONITORING DATA WORKSHEET

The following worksheets have been designed to assist the enforcement official in evaluating the method an owner/operator uses in presenting and statistically analyzing detection monitoring data. This series of worksheets has been compiled to parallel the information provided in Chapter 5 of the TEGD.

I. Presenting Detection Monitoring Data

A. Is the owner/operator using the data reporting sheets as described in the TEGD (Chapter 5)? Don't know (Y/N) NA

B. Have all the detection monitoring data collected by the facility been obtained and reviewed? (Y/N) ____

II. T-test and Number of Wells

No statistics have been done yet

A. Which t-test is in use:
1. Cochran's Approximation to the Behrens-Fisher (CABF t-test)? ____
2. Averaged replicate t-test (AR t-test)? ____
3. Other, describe: ________________________________
____

B. Does the facility have more than one upgradient monitoring well? (Y/N) N

III. First Year's Data

A. Have upgradient wells been monitored to establish background concentrations of the following data on a quarterly basis for one year: Just started Monitoring
1. Appendix III parameters (§265.92(b)(1))? (Y/N) N
2. Ground-water quality parameters (§265.92(b)(2))? (Y/N) NA
3. Ground-water contamination indicator parameters (§265.92(b)(3))? (Y/N) ____

B. Were four replicate measurements obtained from each upgradient well during the first year of quarterly detection monitoring for indicator parameters [§265.92(b)(3)]? (Y/N) ____

C. Have the background mean and variance been determined for the §265.92(b)(3) parameters using all the data obtained from the upgradient wells during the first year of sampling? (Y/N) ____

D. Are background statistics determined from missing data using the criteria discussed in Chapter Four? (Y/N) NA

IV. Subsequent Year's Data

A. Is monitoring data collected after the first year being compared with background data to determine possible groundwater contamination? (Y/N) NA

B. Is the identified approved t-test being used properly to determine possible ground-water contamination? (Y/N)___

C. Are the ground-water quality parameters in §265.92(b)(2) being measured at least annually? (Y/N)___

D. Are the indicator parameters in §265.92(b)(3) being measured in at least four replicate samples from each well in the detection monitoring network at least semi-annually? (Y/N)___

E. Are the indicator parameters collected on a semi-annual basis being used to estimate the mean and variance? (Y/N)___

F. Is the elevation of the water table at each monitoring well determined each time a sample is collected? (Y/N)___

V. Conclusions

A. Is the owner/operator adequately reporting and statistically analyzing the facility's monitoring well data? (Y/N) NA

B. If the t-test indicated a significant increase in IP's for downgradient wells, were they resampled and reanalyzed? (Y/N)___

C. If the resampling still indicated a significant increase, was assessment monitoring begun? (Y/N)___

APPENDIX A.6

ASSESSMENT MONITORING

The following worksheets have been designed to assist the enforcement officer in evaluating an owner/operator's assessment phase ground-water monitoring program. This series of worksheets has been compiled to parallel the information presented in Chapter 6 of the TEGD.

I. Review of Hydrogeologic Descriptions

A. Has the site's hydrogeologic setting been well characterized (refer to Appendix A.1 of TEGD)? (Y/N) N

1. Has the regional and local hydrogeologic setting been thoroughly described? (Y/N) N
2. Is there sufficient direct field information? (Y/N) N
3. Is the information accurate and reliable? (Y/N) Y
4. Was the evaluation performed by a hydrogeologist? don't know (Y/N) NA
5. Did indirect investigatory methods correlate with direct methods? (Y/N) NA
6. Have all possible migration pathways been identified? (Y/N) N
7. Will the description of the hydrogeologic setting aid in characterizing the rate and extent of the plume migration? (Y/N) N

II. Review of Detection Monitoring System Description

A. Is the detection monitoring system capable of detecting all contaminant leakage that may be escaping from the facility (refer to Appendix A.2 of TEGD)? (Y/N) N

1. Are the well designs and construction parameters fully documented? (Y/N) N
2. Have the downgradient wells been strategically located so as to intercept migrating contaminants? (Y/N) N
3. Are upgradient wells positioned so that they are not effected by the facility? (Y/N) N
4. ~~What are the screened intervals?~~ (Y/N) NA
5. Are the well construction materials (e.g., casing, screen, seals, packing) comprised of material that will not affect the ground-water quality? (Y/N) Y

III. Review of Description of Approach for Making First Determination

A. Did the detection monitoring system consistently yield statistically equivalent concentrations for all indicator parameters? statistics Not done Yet (Y/N) NA

B. If no:
1. Were the results based on the Student's t-test at the 0.01 level of significance? (Single-tailed t-test for testing significant increases and two-tailed t-test for testing significant differences in pH values.) (Y/N)___
2. Were the calculations performed correctly? (Y/N)___
3. If the results are deemed as a false positive, did the owner/operator fully document the reasoning? (Y/N)___
4. Is there any reasonable cause to believe that faulty data are responsible for the false positive claim? (Y/N)___
5. Can or will deficiencies in well design, sample collection, sample preservation, or analysis be corrected? (Y/N)___
6. If the owner/operator intends to collect additional data to remedy any inadequacies, will this collection result in an acceptable delay in assessing the extent of contamination at the site? (Y/N)___
7. Will positive results of these determinations initiate a drilling program for assessment monitoring? (Y/N)___

IV. Review of Approach for Conducting Assessment

Assessment Plan Not Developed Yet

A. Have the assessment monitoring objectives been clearly defined in the assessment plan? (Y/N) NA
1. Does the plan include analysis and/or re-evaluation to determine if significant contamination has occurred in any of the detection monitoring wells? (Y/N)___
2. Does the plan provide for a comprehensive program of investigation to fully characterize the rate and extent of contaminant migration from the facility? (Y/N)___
3. Does the plan call for determining the concentrations of hazardous wastes and hazardous waste constituents in the ground water? (Y/N)___
4. Does the plan employ a quarterly monitoring program? (Y/N)___

B. Does the assessment plan identify the investigatory methods that will be used in the assessment phase? (Y/N)___
1. Is the role of each method in the evaluation fully described? (Y/N)___

2. Does the plan provide sufficient descriptions of the direct methods to be used? (Y/N) NA
3. Does the plan provide sufficient descriptions of the indirect methods to be used? (Y/N)
4. Will the method contribute to the further characterization of the contaminant movement? (Y/N)

C. Are the investigatory techniques utilized in the assessment program based on direct methods? (Y/N) NA
   1. Does the assessment approach incorporate indirect methods to further support direct methods? (Y/N)
   2. Will the planned methods called for in the assessment approach ultimately meet performance standards for assessment monitoring? (Y/N)
   3. Are the procedures well defined? (Y/N)
   4. Does the approach provide for monitoring wells similar in design and construction as the detection monitoring wells? (Y/N)
   5. Does the approach employ taking samples during drilling or collecting core samples for further analysis? (Y/N)

D. Are the indirect methods to be used based on reliable and accepted geophysical techniques? (Y/N)
   1. Are they capable of detecting subsurface changes resulting from contaminant migration at the site? (Y/N)
   2. Is the measurement at an appropriate level of sensitivity to detect ground-water quality changes at the site? (Y/N)
   3. Is the method appropriate considering the nature of the subsurface materials? (Y/N)
   4. Does the approach consider the limitations of these methods? (Y/N)
   5. Will the extent of contamination and constituent concentration be based on direct methods and sound engineering judgment? (Using indirect methods to further substantiate the findings) (Y/N)

E. Does the assessment approach incorporate any mathematical modeling to predict contaminant movement? (Y/N)
   1. Will site specific measurements be utilized to accurately portray the subsurface? (Y/N)
   2. Will the derived data be reliable? (Y/N)
   3. Will the model be adequately calibrated with observed physical conditions? (Y/N)
   4. Have the assumptions been identified? (Y/N)
   5. Have the physical and chemical properties of the site-specific wastes and hazardous waste constituents been identified? (Y/N)

Assessment Plan Not Developed Yet

V. Review of Assessment Monitoring Wells

A. Does the assessment plan specify:
   1. The number, location, and depth of wells? (Y/N) NA
   2. The rationale for their placement and identify the basis that will be used to select subsequent sampling locations and depths in later assessment phases? (Y/N)___

B. Does the assessment period consist of a phased investigation so that data gained in initial rounds may help guide subsequent rounds? (Y/N)___
   1. Do initial rounds incorporate geophysical techniques to approximate the limits of the contaminant plume? (Y/N)___
   2. Has information from the triggering well (well showing elevated contaminant concentrations) been incorporated in the initial design and specifications? (Y/N)___
   3. Is the sampling program designed adequately to portray a three dimensional plume configuration? (Y/N)___
   4. Are evaluation procedures in place that will provide further guidance for subsequent monitoring? (Y/N)___

C. Does sufficient hydrogeologic data exist in the direction of the contaminant plume? (Y/N)___
   1. Does the subsurface setting provide any information on possible transport mechanisms and attenuation processes? (Y/N)___
   2. Are provisions made to secure additional data as needed? (Y/N)___
   3. Are hydrogeologic descriptions updated as additional data become available? (Y/N)___

D. Sampling density:
   1. Is the number of monitoring well clusters sufficient to define the horizontal boundaries of the plume? (Y/N)___
   2. Are the well clusters placed both perpendicular and parallel to plume migration from the triggering well? (Y/N)___
   3. Are the well clusters placed both inside and outside the contaminant plume to identify its horizontal boundaries? (Y/N)___
   4. Are sampling locations situated so as to identify areas of maximum contaminant concentration within the plume? (Y/N)___
   5. Does the sampling density correlate with the size of the plume and the geologic variability? (Y/N)___

E. Sampling depths:
   1. Are the intervals over which the samples are collected clearly identified? (Y/N) NA
   2. Are the well screens within each cluster positioned to sample the full extent of the predicted vertical distribution of hazardous waste constituents? (Y/N)____
   3. Are the well screens depth discrete to the extent possible to minimize dilution effects? (Y/N)____
   4. Are there sufficient wells in each cluster to verbally define plume margins? (Y/N)____
   5. Are there wells within each cluster that are screened within the plume? (Y/N)____
   6. Are the wells placed alternating lower and higher screened wells to reduce the effect of drawdown on the sampling horizons? (Y/N)____
   7. Are there high fluctuations in ground-water levels, or is the subsurface characterized by fractured consolidated formations that may otherwise require longer screen lengths? (Y/N)____
   8. Are the wells screened to identify vertical concentration gradients and maximum concentrations of the contaminants? (Y/N)____

VI. Review of Monitoring Well Design and Construction

A. Are the well design and construction specification requirements equivalent to the detection requirements detailed in Chapter 3? (Y/N)____

B. Are well design and construction details provided for:
   1. Drilling methods? (Y/N)____
   2. Well construction materials? (Y/N)____
   3. Well diameter? (Y/N)____
   4. Well intake structures and procedures for well development? (Y/N)____
   5. Placement of annular seals? (Y/N)____

C. Are all these details approved and recommended considering the characteristics of the site? (Y/N)____

VII. Review of Sampling and Analysis Procedures

A. Does the list of monitoring parameters include all hazardous waste constituents from the facility? (Y/N)____

1. Does the water quality parameter list include other important indicators not classified as hazardous waste constituents? (Y/N) NA
2. Does the owner/operator provide documentation for the listed wastes which are not included? (Y/N)

B. Have the procedures been detailed for sample collection? (Y/N)
1. Do the procedures include evacuation of the borehole prior to sample collection? (Y/N)
2. Are special procedures delineated for collection of separate phase immiscible contaminants? (Y/N)
3. Has the equipment been identified? (Y/N)
4. Do the procedures include decontamination of equipment? (Y/N)
5. Have pumping rates, duration, and position in the well from which water will be evacuated been specified? (Y/N)

C. Do the procedures include provisions for sample preservation and shipment? (Y/N)

D. Do the procedures specify:
1. Type of sample containers? (Y/N)
2. Filtering procedures? (Y/N)
3. Preservation techniques? (Y/N)
4. Storage and time elements involved? (Y/N)
5. Proper documentation? (Y/N)

E. Do these procedures correspond to recommended procedures (SW-846 or EPA-approved procedures) for sampling and preservation? (Y/N)

F. Do the sampling and analysis procedures identify analytical procedures for each of the identified monitoring parameters? (Y/N)

G. Do the analytical procedures include:
1. Detailed description and reference of approved analytical methods? (Y/N)
2. QA/QC procedures? (Y/N)
3. Location of laboratory performing analysis? (Y/N)
4. Proper documentation? (Y/N)

H. Does the sampling and analysis plan establish procedures for chain of custody control? (Y/N)

I. Do these procedures include:
1. Sample labels? (Y/N)
2. Sample seals? (Y/N)
3. Field logbook? (Y/N)
4. Chain of custody record? (Y/N)
5. Sample analysis request sheet? (Y/N)
6. Laboratory logbook? (Y/N)

J. Do the procedures specify how assessment monitoring data will be evaluated to determine if contamination has actually occurred? (Y/N) NA
   1. Will the evaluation delineate the full extent of contaminant migration? (Y/N)____
   2. Will significant changes in containment concentration or movement be identified? (Y/N)____
   3. Are the evaluation procedures suitable and objective? (Y/N)____

K. Does the assessment plan clearly describe the procedures that will be used for evaluating monitoring data during the assessment? (Y/N)____

L. Does the plan provide for evaluation of its methodologies to ensure each method is properly executed during the assessment period? (Y/N)____

M. Is a list of all detection monitoring and assessment monitoring (if applicable) data available from the owner/operator? (Y/N)____
   1. Do these lists include:
      - Field quality control samples (e.g., sample container and equipment blanks)? (Y/N)____
      - Laboratory quality control samples (e.g., replicates, spiked samples, etc.)? (Y/N)____
      - Method detection limits? (Y/N)____
   2. Are the lists prepared using a format which presents:
      - Codes that identify GWCCs? (Y/N)____
      - Well number? (Y/N)____
      - Date? (Y/N)____
      - Units of measure? (Y/N)____
      - Less than (LT) detection limit values? (Y/N)____
      - Concentrations of GWCCs? (Y/N)____

N. Has the owner/operator prepared summary statistics tables of the GWCC data? (Y/N)____
   1. Do the summary statistics tables include:
      - Number of LT detection limit values? (Y/N)____
      - Total number of values? (Y/N)____
      - Mean? (Y/N)____
      - Median? (Y/N)____
      - Standard deviation? (Y/N)____
      - Coefficient of variation? (Y/N)____
      - Minimum value? (Y/N)____
      - Maximum value? (Y/N)____
   2. Are there summary statistics tables that present:
      - GWCC? (Y/N)____
      - GWCC by well number? (Y/N)____
      - GWCC by well number and date? (Y/N)____
      - Quality control data? (Y/N)____

172-437 0 - 83 - 10

O. Has the owner/operator simplified the statistical data? (Y/N) NA
   1. Was the data simplified using a ranking procedure for each GWCC-well combination? (Y/N)___
   2. Has the ranking procedure been applied to each GWCC which was detected at least once at every well in the monitoring system? (Y/N)___

P. Did the owner/operator display the data graphically? (Y/N)___
   1. Were the data plotted graphically to evaluate temporal changes? (Y/N)___
   2. Were the data plotted on facility maps to evaluate spacial trends? (Y/N)___

VIII. Review of Migration Rates

A. Did the owner/operator's assessment plan specify the procedures to be used to determine the rate of constituent migration in the ground-water? (Y/N)___

B. Do the procedures incorporate a periodic re-evaluation of sampling data to continually monitor the rate and extent of contaminant migration? (Y/N)___
   1. Do the procedures clearly establish ground-water flow rates and direction downgradient from the detection wells? (Y/N)___
   2. Are the methods employed suitable for these determinations? (Y/N)___
   3. Are the limitations of these methods known and documented? (Y/N)___
   4. Do the evaluations incorporate chemical and physical characteristics of the contaminants and the media? (Y/N)___
   5. Are adsorptive and degradative processes considered in determining any retardation of contaminant movement? (Y/N)___
   6. Have the assumptions been identified and documented? (Y/N)___

C. Does the assessment plan evaluate the presence of immiscible phase layers? (Y/N)___
   1. Do the procedures specify detection and collection of light and dense phase immiscibles prior to well evacuation? (Y/N)___
   2. Has the owner/operator used the slope of the water table and the velocity of ground-water flow to estimate light phase immiscible migration? (Y/N)___
   3. Has the owner/operator defined the configuration of the confining layer to predict dense phase immiscible migration? (Y/N)___

IX. Reviewing Schedule of Implementation

A. Has the owner/operator specified a schedule of implementation in the assessment plan? (Y/N) NA

B. Does the schedule for implementing assessment monitoring data include a timetable for a comprehensive site evaluation for contamination? (Y/N)____

C. Does the timetable include:
   1. A number of milestones used to judge if sufficient progress is being made toward the completion of the assessment during implementation? (Y/N)____
   2. The determination if contamination has occurred? (Y/N)____
   3. Completing an initial comprehensive assessment of contamination at the site? (Y/N)____
   4. Implementing a program for continued monitoring after fully characterizing contamination at the site? (Y/N)____

D. Does this represent an acceptable time frame? (Y/N)____

X. Conclusions

A. Has the owner/operator adequately characterized site hydrogeology to determine contaminant migration? (Y/N)____

B. Is the detection monitoring system adequately designed and constructed to immediately detect any contaminant release? (Y/N)____

C. Are the procedures used to make a first determination of contamination adequate? (Y/N)____

D. Is the assessment plan adequate to detect, characterize, and track contaminant migration? (Y/N)____

E. Will the assessment monitoring wells, given site hydrogeologic conditions, define the extent and concentration of contamination in the horizontal and vertical planes? (Y/N)____

F. Are the assessment monitoring wells adequately designed and constructed? (Y/N)____

G. Are the sampling and analysis procedures adequate to provide true measures of contamination? (Y/N)____

H. Do the procedures used for evaluation of assessment monitoring data result in determinations of the rate of migration, extent of migration, and hazardous constituent composition of the contaminant plume? (Y/N)____

I. Are the data collected at sufficient duration and frequency to adequately determine the rate of migration? (Y/N) NA

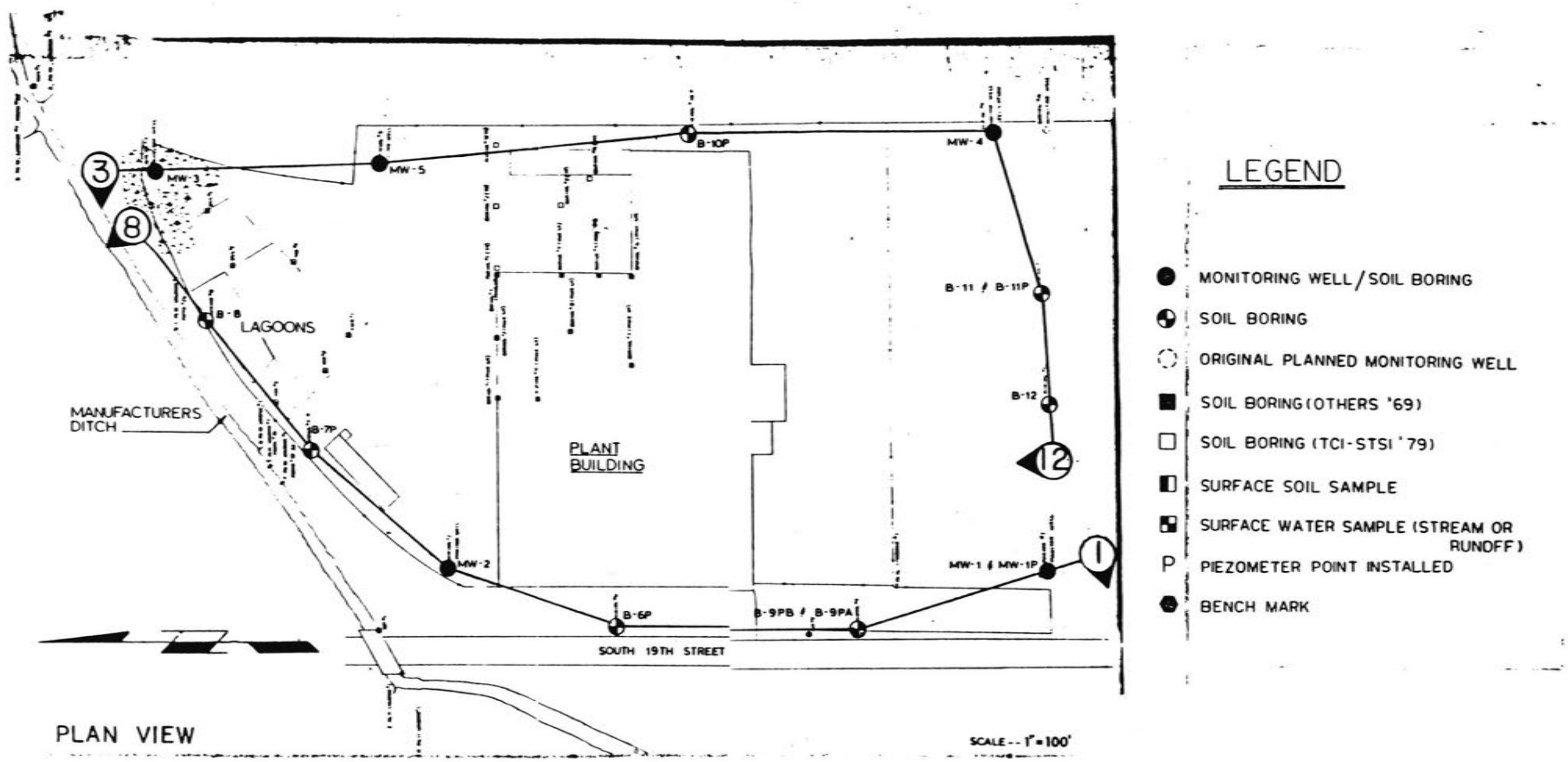
J. Is the schedule of implementation adequate? (Y/N)

K. Is the owner/operator's assessment monitoring plan adequate? (Y/N)
   1. If the owner/operator had to implement his assessment monitoring plan, was it implemented satisfactorily? (Y/N)

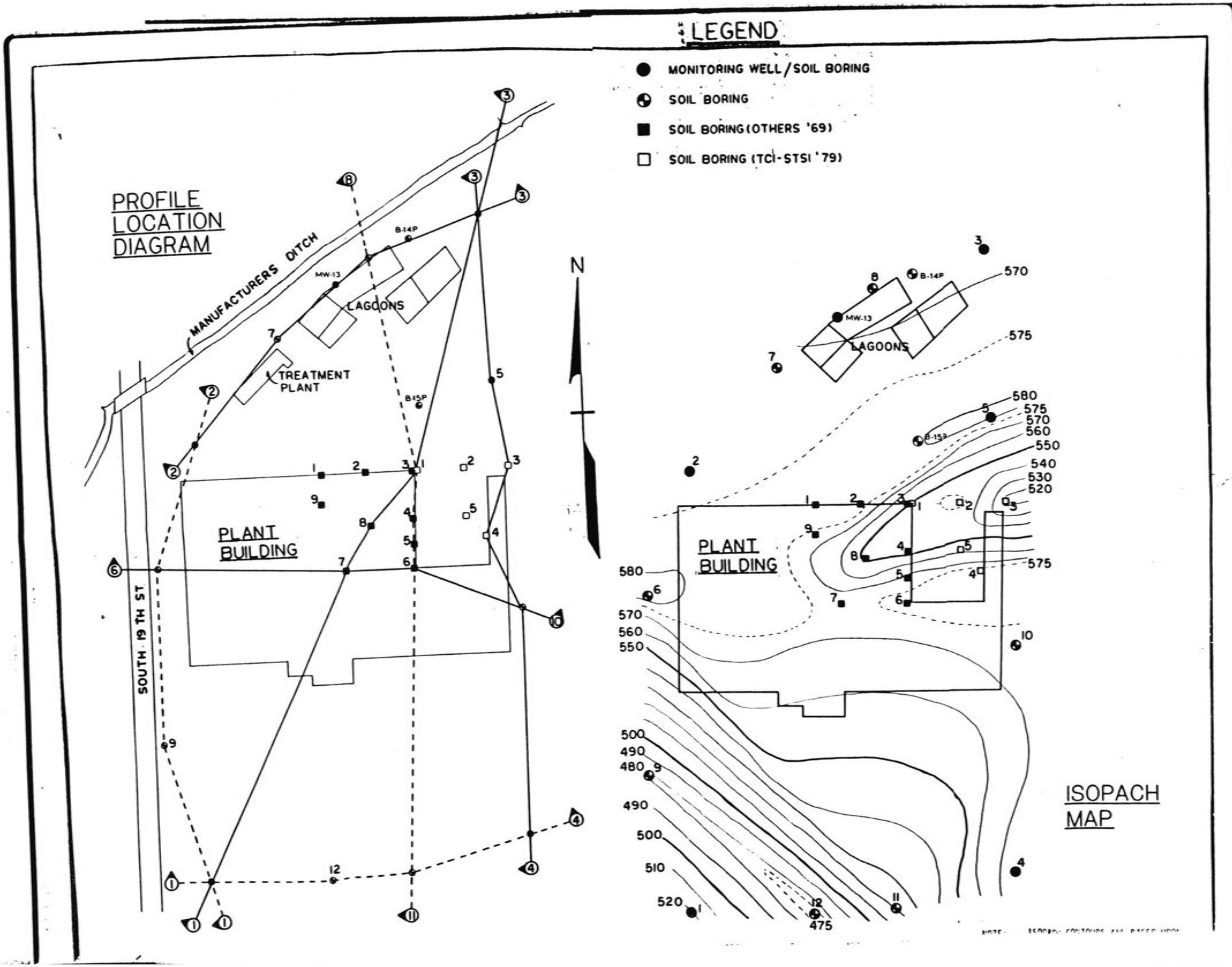
- Isopach maps
- Cross sections
- Updated groundwater contour maps

ATTACHMENT 2

BORING LOGS, CROSS-SECTIONS, ISOPACH MAPS, AND LOCATION MAPS



MW-3
MW-5
B-10P
MW-4
B-8
LAGOONS
MANUFACTURERS DITCH
B-7P
PLANT BUILDING
MW-2
B-6P
SOUTH 19TH STREET
B-9PB & B-9PA
MW-1 & MW-1P
B-11 & B-11P
B-12
3
8
12
1
PLAN VIEW
SCALE -- 1" = 100'
LEGEND
MONITORING WELL / SOIL BORING
SOIL BORING
ORIGINAL PLANNED MONITORING WELL
SOIL BORING (OTHERS '69)
SOIL BORING (TCI-STSI '79)
SURFACE SOIL SAMPLE
SURFACE WATER SAMPLE (STREAM OR RUNOFF)
P PIEZOMETER POINT INSTALLED
BENCH MARK



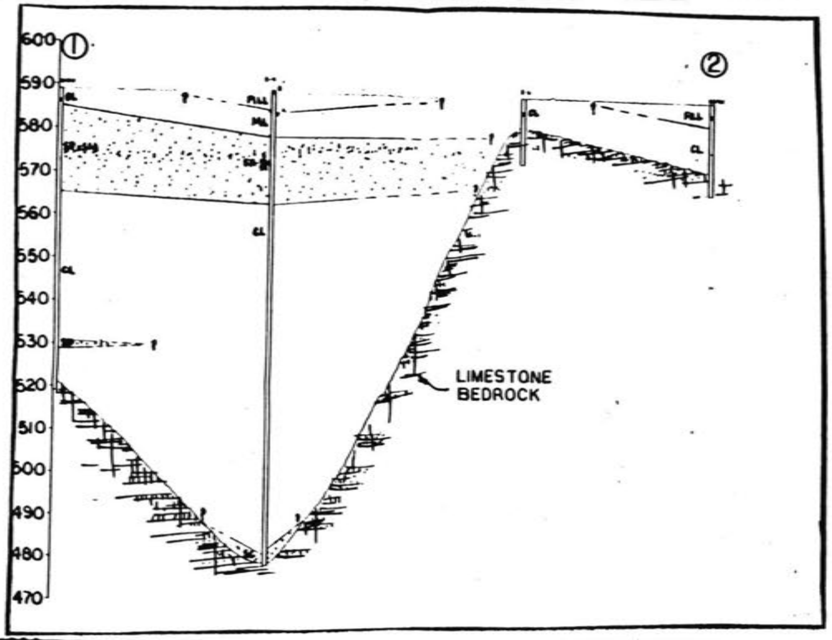
REVISIONS	BY
JUNE 21 1984 ADDED MW 13 & B14-15	JFH

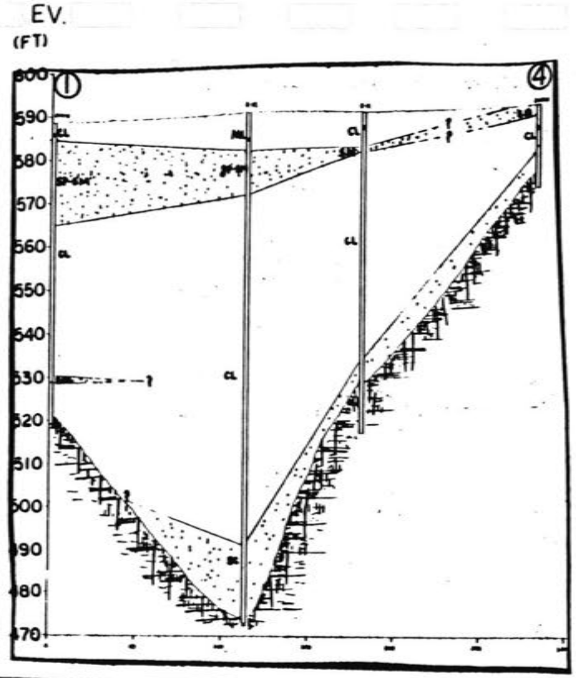
ISOPACH MAP AND PROFILE LOCATION DIAGRAM

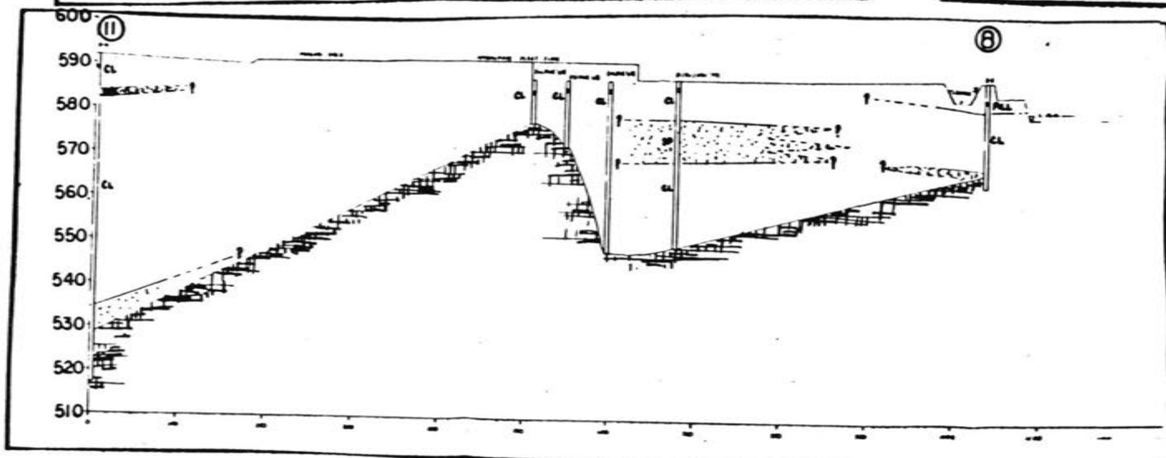
PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORP./ COLLIS DIVISION
CLINTON, IOWA

TERRACON CONSULTANTS, INC.

DRAWN JH / DSM
CHECKED JOHN F HARTWEL
DATE 8-10-83
SCALE 1" = 100'







NOTE: STRATA LINES ARE BASED UPON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

100 0 100 200
scale HORIZONTAL feet

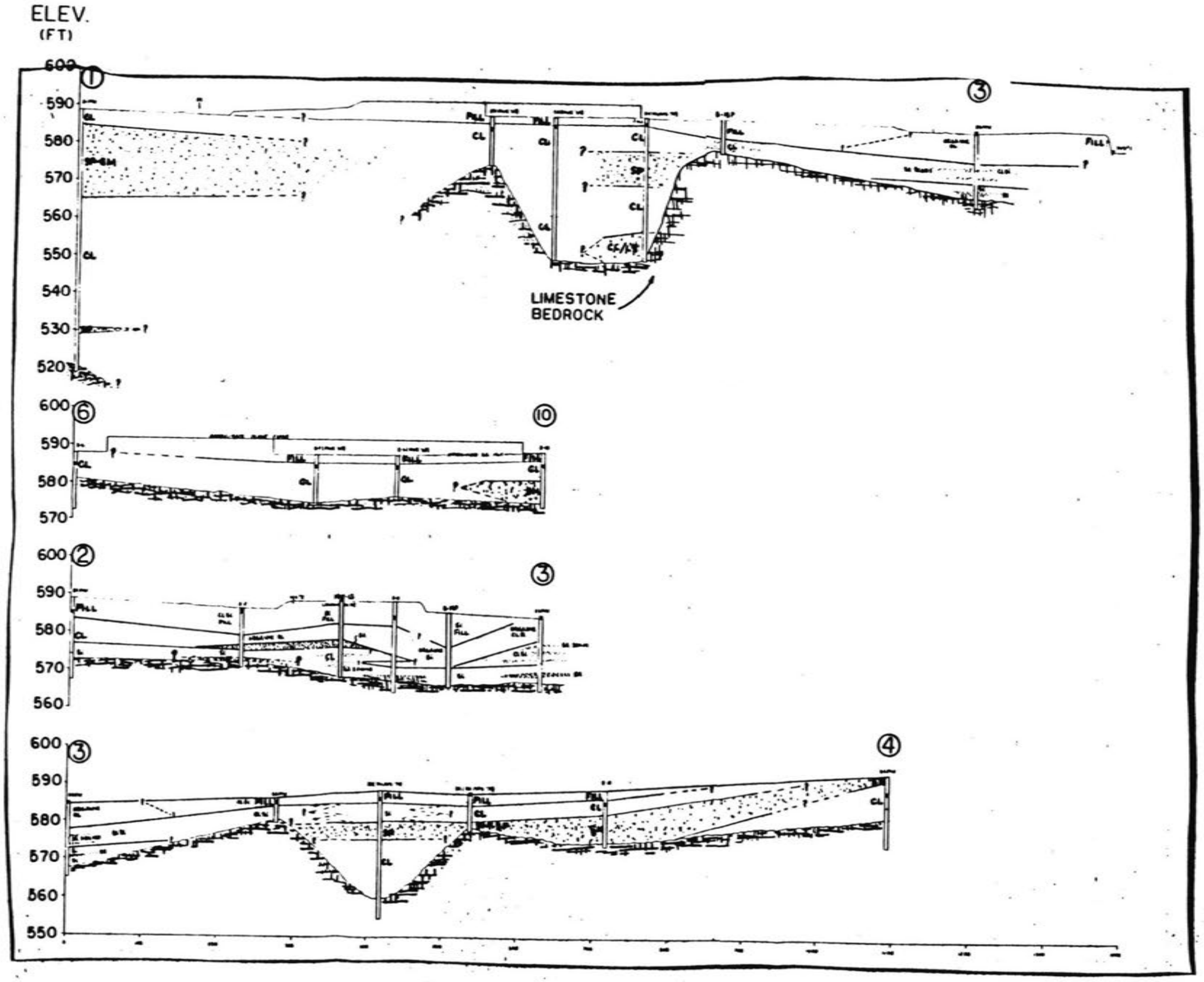
STRATIGRAPHIC PROFILES

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORP./ COLLIS DIVISION
CLINTON, IOWA

TERRACON CONSULTANTS, INC.

COPY

DRAWN	[illegible]
CHECKED	JOHN F HARTWELL
DATE	8-9-83
SCALE	1" =100'
JOB NO.	783501
SHEET	3 OF 5 SHEETS



NOTE: STRATA LINES ARE BASED UPON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

100 0 100 200
scale HORIZONTAL feet

STRATIGRAPHIC PROFILES

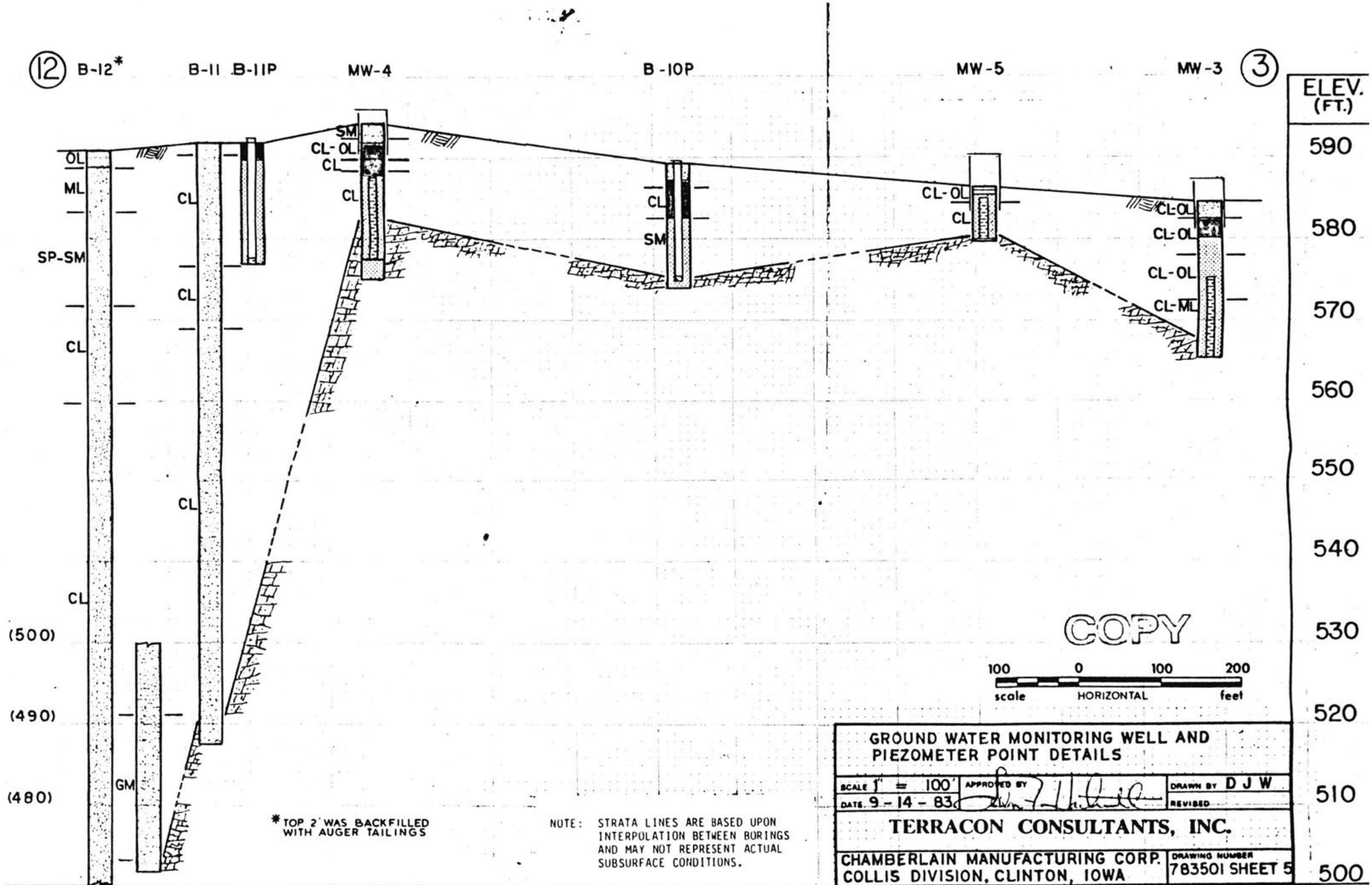
PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORP./ COLLIS DIVISION
CLINTON, IOWA

TERRACON CONSULTANTS, INC.

'84 AUG ... AM 11 47

DRAWN	DEK - JH
CHECKED	JOHN F. HARTWELL
DATE	8-9-83
SCALE	1" = 100'
JOB NO.	783501
SHEET	4

OF 5 SHEETS



* TOP 2' WAS BACKFILLED WITH AUGER TAILINGS

NOTE: STRATA LINES ARE BASED UPON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

GROUND WATER MONITORING WELL AND PIEZOMETER POINT DETAILS

SCALE 1" = 100'	APPROVED BY	DRAWN BY D J W	
DATE 9 - 14 - 83		REVISED	

TERRACON CONSULTANTS, INC.

CHAMBERLAIN MANUFACTURING CORP.
COLLIS DIVISION, CLINTON, IOWA

DRAWING NUMBER 783501 SHEET 5

5 OF 5

5 SECTION FULL DOT

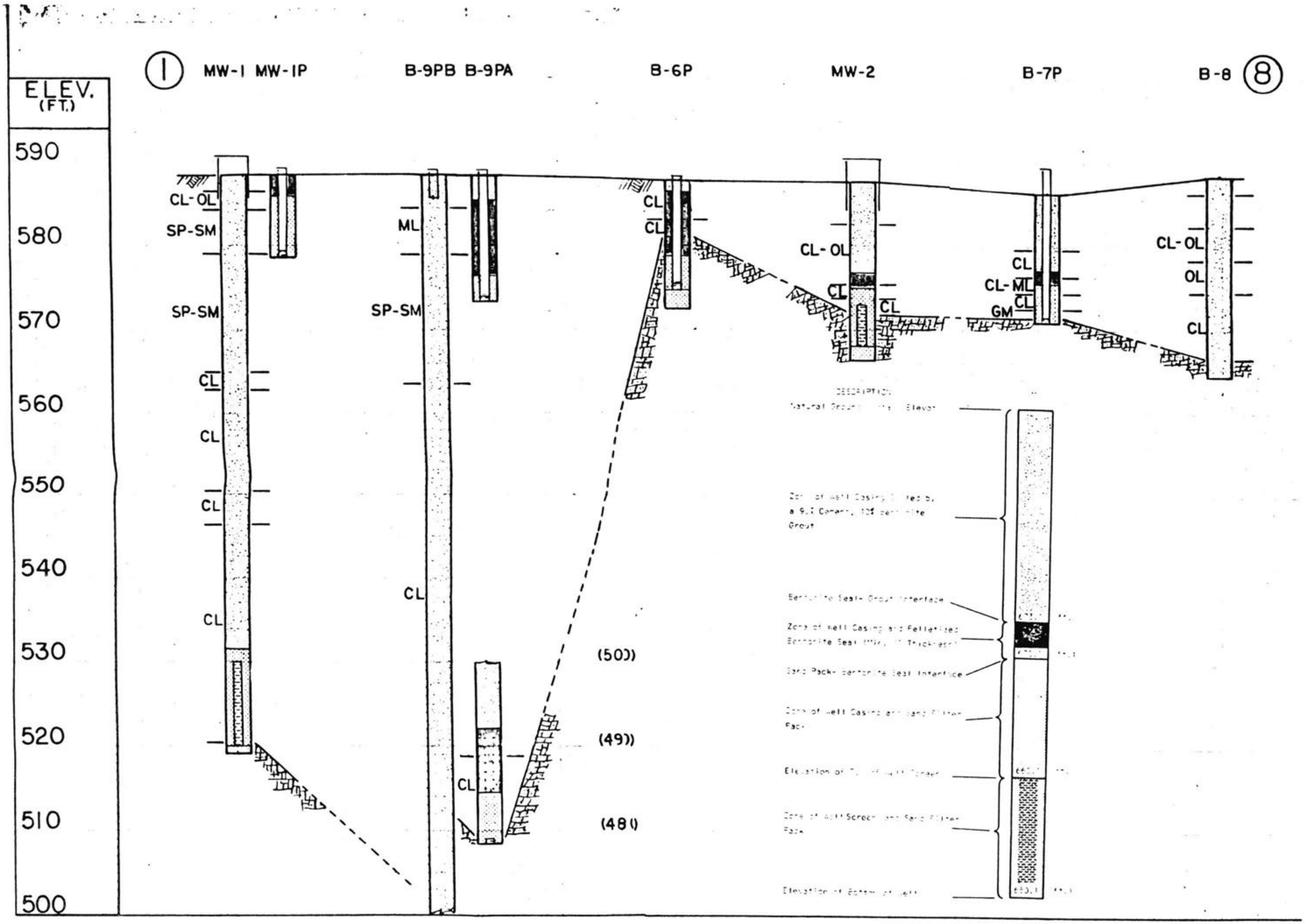


PLATE 4-SINGLE PL

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS	:	Split Spoon—1⅜" I.D., 2" O.D., unless otherwise noted
ST	:	Shelby Tube—2" O.D., unless otherwise noted
PA	:	Power Auger
HA	:	Hand Auger
DB	:	Diamond Bit—4 in, N, B
AS	:	Auger Sample
HS	:	Hollow Stem Auger
VS	:	Vane Shear
PS	:	Piston Sample
WS	:	Wash Sample
FT	:	Fish Tail
RB	:	Rock Bit
BS	:	Bulk Sample
PM	:	Pressuremeter
DC	:	Dutch Cone

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL	:	Water Level
WCI	:	Wet Cave In
DCI	:	Dry Cave In
AB	:	After Boring
WS	:	While Sampling
WD	:	While Drilling
BCR	:	Before Casing Removal
ACR	:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In low permeability soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence of ground water elevations must be sought.

DESCRIPTIVE SOIL CLASSIFICATION:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50 % of their dry weight retained on a #200 sieve; they are described as: clays, or clayey silts if they are cohesive, and silts if they are slightly cohesive or non-cohesive. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their consistency and plasticity. Example: Clayey silt, trace sand moderately plastic, stiff; silty fine sand, trace gravel, medium dense.

GRAIN SIZE TERMINOLOGY

Major Component Of Sample	Size Range
Boulders	Over 8 in. (200mm)
Cobbles	8 in. to 3 in. (200mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 2mm)
Sand	#4 to #200 sieve (2mm to .074mm)
Silt or Clay	Passing #200 sieve (0.074mm)

RELATIVE PROPORTIONS

Descriptive Term(s) (Of Components Also Present in Sample)	Percent of Dry Weight
Trace	1-10
Little	10-20
Some	20-35
And	35-50

RELATIVE DENSITY OF GRANULAR SOILS:

N-Blows/ft.	Relative Density
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
80 +	Extremely Dense

CONSISTENCY OF COHESIVE SOILS:

Unconfined Compressive Strength, Qu, psf	Consistency
< 500	Very Soft
500- 1,000	Soft
1,000- 2,000	Medium
2,000- 4,000	Stiff
4,000- 8,000	Very Stiff
8,000-16,000	Hard
> 16,000	Very Hard

PLASTICITY OF FINE GRAINED SOILS:

Term	Plasticity Index
None to slight	0- 3
Slight	4- 7
Moderate	8-25
High	> 25

LOG OF BORING NO. 1

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

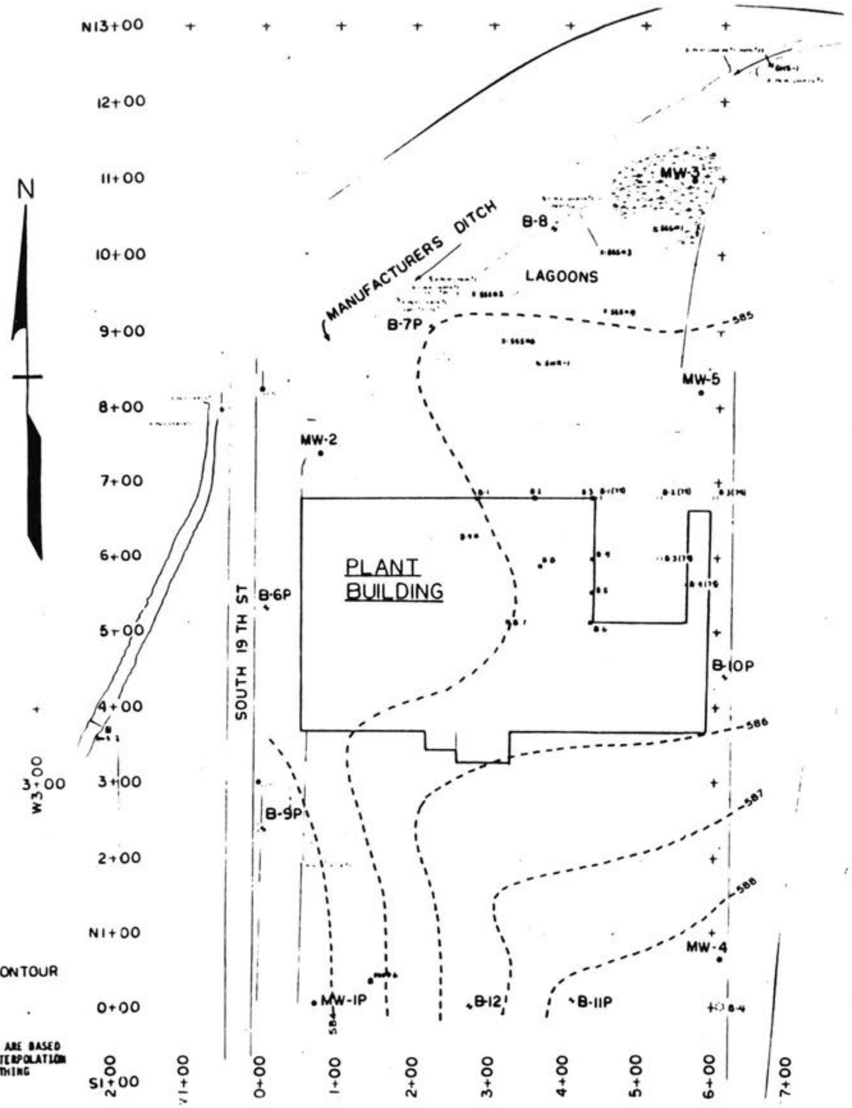
Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.5	pH
1	ST	24	6		37.8	35.4	80	CL-OL		586.5 (2.0')	SEE NOTE #1	7.00
2	ST	24	5		31.1	33.3 22.3	84	CL-OL CL		584.2 (4.3')	CLAYEY SILT, TRACE SAND Dark Brown to Gray Brown	6.10
3	ST	24	4		14.4	28.9		SM	5		SILTY FINE SAND Gray Brown	7.20
4	SS HS	18	18	10	1.5	23.7		SP-SM			Clayey Silt Seam at 8.0 - 8.2	7.60
5	SS HS	18	18	13	2.9	23.7		SP-SM		579.0 (9.5')	Loose to Medium Dense	7.20
6	SS HS	18	18	10	3.3	21.1		SP-SM	10		SAND, FINE TO MEDIUM, TRACE SILT	5.70
7	SS HS	18	18	15	1.3	20.3		SP-SM			Brown Loose to Medium Dense	7.40
8	SS HS	18	18	9	2.0	20.8		SP-SM	15			7.50
9	SS HS	18	12	11	2.0	24.6		SP-SM				7.60
10	SS HS	18	18	18	2.8	22.5		SP-SM	20			7.70
11	SS HS	18	18	33	1.3	18.1		SP-SM				7.70
12	SS HS	18	16	57	1.6	20.3		SP-SM		565.0 (23.5')		7.70
13	SS HS	18	18	24	8.9	23.7		CL	25	563.0 (25.5')	SILTY CLAY, TRACE SAND Gray Brown	7.70
14	SS HS	18	8	25	14.4	24.6		CL			CLAYEY SILT, TRACE SAND Gray/Brown	
15	ST	24	13		10.9	24.6	101	CL	30		Reddish Gray at 32.0	6.80
											Continued	
											NOTE #1: SILT, LITTLE CLAY, TRACE SAND AND ROOTS Dark Brown	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 5.5	W.S. OR W.D.		A.B.
W.L.	B.C.R.	12.8	A.C.R.
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	4-20-83
BORING COMPLETED	4-20-83
RIG Bomb 6	FOREMAN DEK
APPROVED	JOB # 783501



/ GROUND WATER LEVEL CONTOUR OBTAINED 5-16-83

NOTE: GROUND WATER CONTOURS ARE BASED UPON STRAIGHT LINE INTERPOLATION WITH MINOR CURVE SMOOTHING BETWEEN DATA POINTS.

LEGEND

- ● MONITORING WELL / SOIL BORING
- SOIL BORING
- ORIGINAL PLANNED MONITORING WELL
- ■ SOIL BORING (OTHERS '69)
- □ SOIL BORING (TCI-STSI '79)
- SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE (STREAM OR RUNOFF)
- P PIEZOMETER POINT INSTALLED
- BENCH MARK

GROUND WATER CONTOUR MAP AND LOCATION DIAGRAM

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORP / COLLIS DIVISION
CLINTON, IOWA

TERRACON CONSULTANTS, INC.

COPY

DRAWN	JH/DSM
CHECKED	JOHN F. HARTWELL
DATE	8-8-83
SCALE	1" = 100'
JOB NO.	783501
SHEET	1A

LOG OF BORING NO. 1 (CONTINUED)

OWNER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.

ARCHITECT-ENGINEER

SITE
CLINTON, IOWA

PROJECT NAME
COLLIS PHASE MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.3	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.5	pH
									30		CONTINUED FROM SHEET #1	
16	ST	24	3		22.2	22.8	104	CL				
17	ST	24	10		15.9	23.4	102	CL			CLAYEY SILT, TRACE SAND	6.90
	HS								35		Reddish Gray Silt and Sand Seams at 36.0 - 38.0	
18	ST	24	16		13.0	28.7	94	CL		550.5	(38.0')	8.10
19	ST	24	16		44.4	26.8	94	CL	40		SILTY CLAY, TRACE SAND Gray to Gray Brown	8.10
20	ST	24	16		17.8	27.4	95	CL		546.5	(42.0')	8.00
21	ST	24	18		15.6	22.3	104	CL			CLAYEY SILT, TRACE SAND	7.30
22	ST	24	18		12.6	22.1	106	CL	45		NUMEROUS SILTY CLAY AND SILT SEAMS Gray Brown	7.30
23	ST	24	15		8.3	20.8	107	CL				7.40
24	ST	24	18		11.1	22.1	105	CL	50			6.90
25	ST	24	18		11.1	20.4	110	CL				6.80
26	ST	24	15		8.7	18.4	109	CL			Sand Seams Below 58.0	6.80
27	ST	24	17		12.8	20.9	108	CL	55			7.20
28	ST	24	14		7.9	15.9	112	CL				7.30
29	ST	24	15		3.9	19.8	108	CL	60			7.80
											CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED 4-20-83	
BORING COMPLETED 4-20-83	
RIG Bomb 6	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 1 (CONTINUED)

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.5	pH
									60		CONTINUED FROM SHEET #1	
30	ST	24	15		7.8	19.8	107	CL			CLAYEY SILT, TRACE SAND, NUMEROUS SILTY CLAY AND SILT SEAMS	7.80
31	ST	24	13		42.6	24.1	103	CL			Grayish Brown	6.40
32	ST	24	15		13.9	18.8	108	CL	65			7.10
33	ST	24	12		19.4	25.7	102	CL		520.5	(68.0')	7.30
34	SS	4	0	70/4"						519.1	(69.4') SEE NOTE #1	7.80
35	SS	1	1	70/1"	1.4	8.3			70			

Auger Refusal @ 69.4

BOTTOM OF BORING

NOTE #1:

LIMESTONE HIGHLY WEATHERED
Brown

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

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BORING STARTED 4-20-83	
BORING COMPLETED 4-20-83	
RIG Bomb 6	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 2

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

SURFACE ELEVATION = 587.8

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description	pH
1	SS	18	14	9	8.2	15.7					FILL: CRUSHED LIMESTONE, CINDERS, AND SILT LITTLE CLAY, TRACE SAND	7.22
	HS											
2	SS	18	12	6	13.1	15.7					Brown to Dark Brown	7.20
	HS										Loose	
3	SS	18	12	5	84.4	49.5			5	582.5	(5.3')	7.20
	HS										CLAYEY SILT, TRACE SAND	
4	SS	18	12	3	31.5	47.4		CL-OL			Gray to Dark Gray/Brown Organic	7.27
	HS										Peat Seams @ 8.0-12.0	
5	SS	18	18	3	40.2	53.5		CL-OL	10			7.22
	HS											
6	ST	24	16		27.4	47.4	94	CL-OL		575.8	(12.0')	7.05
											SILT, LITTLE CLAY, TRACE SAND, Gray	
7	ST	24	16		14.9	32.3	88	CL		573.8	(14.0')	8.01
									15		CLAYEY SILT, TRACE SAND	
8	ST	24	13		12.6	40.9	75	CL		571.8	(16.0') Reddish Gray	7.10
9	SS	18	10	31	3.9	8.9					LIMESTONE, HIGHLY WEATHERED AND BROKEN	8.08
	HS										Brown	
10	SS	18	11	40	10.0	12.4			20		Dense	7.85
	HS											
11	SS	18	12	43	10.3	18.1				566.3	(21.5')	7.94
									25		BOTTOM OF BORING	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 3.3	W.S. OR W.D.		A.B.
W.L. 6.2	B.C.R.		A.C.R.
W.L.			

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BORING STARTED 4-27-83	
BORING COMPLETED 4-27-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB #783501

LOG OF BORING NO. 3

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.3	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 584.5	pH
1	ST	24	7		116.7	40.5	89	CL-OL		582.5	(2.0') SEE NOTE #1	6.97
2	ST	24	12		58.3	189.1	26	OL			CLAYEY SILT, TRACE SAND Dark Brown to Dark Gray/	7.57
3	ST	24	7		87.8	98.9	46	CL-OL	5		Brown Organic	7.44
4	ST	24	12		38.9	82.0 29.9	49 85	OL CL-OL		578.0	(6.5') CLAYEY SILT, NUMBEROUS SILT AND SAND SEAMS	7.90
5	ST	24	12		8.4	86.8 28.1	56	OL CL-OL	10		Gray to Dark Gray Brown Organic	7.75
6	ST	24	15		5.7	27.8 96.1	88 49	OL CL		572.5	(12.0')	7.45
7	ST	24	16		15.6	31.5		CL-ML			SILT, LITTLE CLAY, TRACE SAND Gray to Reddish Gray	7.82
8	ST	24	17		25.0	24.3	83	CL	15		Sand Seams Below 14.0	7.53
9	ST	12	13		22.2	31.7	90	CL		567.5	(17.0')	
10	HS SS	6	6	67/6"	4.1			--			LIMESTONE, HIGHLY WEATHERED AND BROKEN	
									20	565.2	(19.3') BOTTOM OF BORING	

AUGER REFUSAL @ 19.3

NOTE #1:

SILT, LITTLE CLAY, TRACE SAND AND ROOTS
Dark Brown
Organic

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	3'	W.S. OR W.D.	A.B.
W.L.		B.C.R.	4.5' A.C.R.
W.L.			

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BORING STARTED 4-28-83	
BORING COMPLETED 4-28-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 4

OWNER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.

ARCHITECT-ENGINEER

SITE
CLINTON, IOWA

PROJECT NAME
COLLIS PHASED MONITORING PROGRAM

SURFACE ELEVATION = 594.3

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	
1	ST	24	5		9.3	21.6	97	SM	7.27
2	SS	18	18	7	17.2	28.3		CL-OL	8.18
	HS					18.1	98		
3	ST	24	8		8.5	23.6		CL	7.45
4	ST	24			16.3	32.3		CL	
5	SS	18	18	14	12.6	27.8		CL	7.58
	HS								
6	ST	24	10		24.1	29.1	90	CL	7.51
7	SS	18	18	66	2.4	15.1		CL	8.08
8	SS	18	18	25	12.2	30.7		CH	7.48
	HS								
9	SS	5	5	60/5"	16.1	30.7		---	7.53
	HS								
10	SS	12	11	61/3"	---	15.4		---	7.50

Elevation	Depth	Description
592.3	(2.0')	SILTY FINE SAND Dark Brown
589.9	(4.4')	SILT, LITTLE TO SOME SAND, TRACE TO LITTLE CLAY, Dark Brown
588.3	(6.0')	SANDY SILTY CLAY, TRACE SAND, Brown
582.5	(11.8')	SILTY CLAY, TRACE SAND Brown to Brown Gray Occasional Highly Weathered Limestone and Sandstone Gravel below 10.0
578.3	(16.0')	LIMESTONE AND SANDSTONE, HIGHLY WEATHERED AND BROKEN, WITH CLAY SEAMS White to Yellow/Brown Talus or Interbedding
575.1	(19.2')	LIMESTONE, HIGHLY WEATHERED, MODERATELY BROKEN, Brown to Yellow Brown

BOTTOM OF BORING

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS

W.L. 11.5	W.S. OR W.D.		A.B.
W.L. 14.3	B.C.R.		A.C.R.
W.L.			

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BORING STARTED 4-20-83
BORING COMPLETED 4-20-83
RIG Bomb — FOREMAN DEK
APPROVED JFH — JOB # 783501

LOG OF BORING NO.5

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELELVATION = 586.4	pH
1	ST	24	7		60.0	56.3		CL-OL		584.4	(2.0') SEE NOTE #1	6.92
2	ST	24	4		33.3	28.3	86	CL	5		CLAYEY SILT, TRACE SAND Dark Gray to Brown	6.41
3	ST	24	3		---	21.1		CL		580.4	(6.0')	5.93
4	SS	5	4	60/5"	2.8	15.6				579.7	(6.7') SEE NOTE #2	8.27
									10		BOTTOM OF BORING	

NOTE #1:

FILL: CLAYEY SILT, TRACE SAND AND ROOTS AND SILT, LITTLE CLAY, TRACE SAND
Dark Brown

NOTE #2:

LIMESTONE, HIGHLY WEATHERED AND BROKEN
Brown

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	5.0	W.S. OR W.D.		A.B.
W.L.	4.3	B.C.R.	2.4	A.C.R.
W.L.				

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BORING STARTED	4-28-83		
BORING COMPLETED	4-28-83		
RIG	Bomb	FOREMAN	DEK
APPROVED	JFH	JOB #	783501

LOG OF BORING NO. 6

OWNER	ARCHITECT-ENGINEER
COLLIS/ DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 587.9	pH
	ST	24	5		31.1	16.7	96	CL			SILT, TRACE TO LITTLE CLAY AND SAND Dark Brown	6.26
	HS					19.3		CL	5	583.1	(4.8')	
2	ST	24	6		19.2	32.3		CL		581.1	CLAYEY SILT, TRACE SAND Dark Gray (6.8')	7.02
	HS								10		LIMESTONE, HIGHLY WEATHERED AND BROKEN WITH OCCASIONAL THIN CLAY SEAMS Brown to Gray	7.48
3	SS	18	14	65	7.2	18.6		--				
	HS											6.61
	SS	8	7	50/2"	20.3	---		---	15	572.6	(15.3')	
									20		BOTTOM OF BORING	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS						
W.L.	6.5	W.S. OR W.D.		A.B.	BORING STARTED	5-3-83
W.L.	4.8	B.C.R.	6.0	A.C.R.	BORING COMPLETED	5-3-83
W.L.					RIG Bomb	FOREMAN DEK
					APPROVED JFH	JOB # 783501

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LOG OF BORING NO. 7

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description (SURFACE ELEVATION = 586.4)	pH
1	ST	24	8		14.6	22.0	93				FILL: CLAYEY SILT, TRACE SAND, GRAVEL AND CINDERS Dark Brown	5.65
2	ST	24	7		23.2	29.9	86					9.07
3	ST	24	6		50.6	27.8	78		5			7.63
						40.5				579.7	(6.7')	
4	ST	24	11		35.1	67.5	63	CL			CLAYEY SILT, TRACE SAND AND ORGANICS Gray to Gray/Green	5.60
5	ST	24	12		21.1	80.9	48	OL-CL	10	576.4	(10.0')	7.33
6	ST	24	10		5.6	22.5	101	CL-ML		574.4	SEE NOTE #1 (12.0')	6.66
7	ST	24	9		13.3	27.4	90	CL		572.4	(14.0') CLAYEY SILT, TRACE SAND Reddish Gray	7.22
8	SS	12	12	80	3.1			GM	15	571.4	(15.0') SEE NOTE #2	7.48
										571.0	(15.4') SEE NOTE #3	
											BOTTOM OF BORING	
									20			

NOTE #1:

SILT, LITTLE CLAY AND SAND WITH SAND SEAMS
Gray

NOTE #2:

SILTY FINE TO MEDIUM SAND, TRACE GRAVEL AND LIMESTONE GRAVEL, Brown

NOTE #3:

LIMESTONE, HIGHLY WEATHERED, MODERATELY BROKEN, . Brown to Yellow/Brown

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 12.0	W.S. OR W.D.		A.B.
W.L. 3.0	B.C.R.		A.C.R.
W.L.			

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BORING STARTED	5-2-83
BORING COMPLETED	5-2-83
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 8

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description (SURFACE ELEVATION = 588.5)	pH
1	ST	24	4		18.3	15.1	96			586.5	(2.0') FILL: SILT AND SANDY SILT TRACE CLAY, TRACE ROOTS Dark Brown	7.86
2	ST	24	11		24.4	20.9	97				FILL: CLAYEY SILT, TRACE TO LITTLE SAND	7.27
3	ST	24	6		39.8	28.3	84		5	582.5	(6.0') Dark Brown	7.07
4	ST	24	6		23.9	56.8		CL-OL			CLAYEY SILT, TRAEE SAND AND SILT, LITTLE CLAY, TRACE SAND, Dark Brown	7.29
5	ST	24	8		31.8	95.3	42	OL	10	578.5	(10.0') Alluvial; Trace Organics Below 8.0	7.25
6	ST	24	20		26.1	47.2	98	CL-OL			CLAYEY SILT, TRACE SAND WITH ORGANICS Gray to Dark Gray	7.12
7	ST	24	14		----	62.2	53	OL		574.5	(14.0') Alluvial	7.53
8	ST	24	14		22.2	30.1	88	CL-ML	15		SILT, LITTLE CLAY, TRACE SAND Gray	7.73
9	ST	24	18		----	39.1	82	CL			Organic Layer @ 16.6-17.2	7.67
10	ST	24	17		----	32.3	88	CL	20		Red Gray with Fine Sand Seams at 20.0 to 22.0	7.73
11	ST	24	13		16.1	34.3	84	CL		566.5	(22.0')	7.83
12	SS	18	16	79	22.2	17.0				564.5	SEE NOTE #1 (24.0')	8.48
									25		BOTTOM OF BORING	
									30		NOTE #1: LIMESTONE, HIGHLY WEATHERED AND BROKEN Brown to Yellow/Brown	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	8.0	W.S. OR W.D.		A.B.
W.L.	5.0	B.C.R.		A.C.R.
W.L.				

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BORING STARTED	4-29-83		
BORING COMPLETED	4-29-83		
RIG	Bomb	FOREMAN	DEK
APPROVED	JFH	JOB #	78350T

LOG OF BORING NO. 9

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.4	pH
											(.2) ASPHALT PAVING	
	HS										FILL: CLAYEY SILT AND WEATHERED, BROKEN LIMESTONE, Brown	
1	SS	18	6	31	5.0					584.4	(4.0')	7.80
	HS								5			
2	ST	24	4		28.2	35.8		ML			CLAYEY SILT, TRACE TO LITTLE SAND WITH SAND SEAMS Gray and Brown	6.70
	HS									578.8	(9.6')	
						24.1	101	ML	10			
3	ST	24	13		10.8	19.4		SM			SILTY SAND, FINE TO MEDIUM Gray Medium Dense	6.87
	HS											
4	SS	18	16	11	4.1	22.7		SP-SM	15			6.74
	HS											
5	SS	18	15	30	2.1	22.3		SP-SM	20			6.98
	HS											
						15.0		SM	25	563.4	(25.0')	
6	SS	18	16	21	6.1	23.7		CL			CLAYEY SILT, TRACE SAND WITH NUMEROUS SILT AND SILTY CLAY LAYERS Gray to Reddish Brown	7.29
	HS								30			
7	ST	24	17		18.9	25.2	101	CL		556.9	(31.5')	7.14
											CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 11.5	W.S. OR W.D.		A.B.
W.L. 23.9	B.C.R.		A.C.R.
W.L.			

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BORING STARTED	5-3-83
BORING COMPLETED	5-3-83
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 9 (CONTINUED)

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

SURFACE ELEVATION = 588.4

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	pH
	HS								
8	ST	24	5		15.6	24.6	95	CL	6.75
	HS								
9	ST	24	15		13.3	23.4	104	CL	6.86
	HS								
10	ST	24	16		20.4	21,4	104	CL	7.90
	HS								
11	ST	24	15		12.2	25.0	102	CL	6.75
	HS								
12	ST	24	16		15.0	21.1	103	CL	7.62
	HS								

Depth: 30 – 60

CONTINUED FROM SHEET #1

(31.5')

CLAYEY SILT, TRACE SAND

Gray to Reddish Gray at 34.5

(59.5')

CONTINUED

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

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BORING STARTED 5-3-83	
BORING COMPLETED 5-3-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 9 (Continued)

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	PROJECT NAME
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.4	pH
											CONTINUED FROM SHEET #2 (59.5')	
									60			
13	ST	24	13		18.9	20.8	102	CL			CLAYEY SILT, TRACE SAND Reddish Gray to Gray	7.26
	HS								65			
14	ST	24	15		11.7	22.7	103	CL				7.67
	HS								70			
15	ST	24	16		14.3	22.3	98	CL				7.92
	HS								75			
16	ST	24	14		17.2	24.6	101	CL				8.04
	HS								80			
17	ST	24	18		26.3	23.2	100	CL				7.89
	HS								85			
18	ST	24	14		---	22.5	105	CL				8.01
	HS										(89.5')	
									90		CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc. Cedar Falls Cedar Rapids Davenport Des Moines, IA Kansas City Wichita, KS Oklahoma City Tulsa, OK	BORING STARTED 5-3-83	
W.L.	W.S. OR W.D.	A.B.		BORING COMPLETED 5-3-83	
W.L.	B.C.R.	A.C.R.		RIG Bomb	FOREMAN DEK
W.L.				APPROVED JFH	JOB # 783501

LOG OF BORING NO. 9 (CONTINUED)

OWNER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.

ARCHITECT-ENGINEER

SITE
CLINTON, IOWA

PROJECT NAME
COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 588.4	pH
											CONTINUED FROM SHEET #3 (89.5')	
									90			
19	ST	24	13		17.8	23.7	103	CL				8.28
	HS										CLAYEY SILT, TRACE SAND Reddish Gray to Gray	
									95			
20	ST	24	15		15.5	25.9	99	CL				7.07
	HS									488.9	(99.5)	
									100			
21	ST	24	11		---	22.8	104	CL			SILT CLAY, TRACE SAND Gray Little to Some Limestone Gravel and Coarse Sand Beginning at 106.5	6.78
	HS											
									105			
22	ST	24	4		18.3	19.1		CL				7.75
	HS									479.1	(109.3')	
23	SS	6	6	95*	7.0				110	478.4	(110.0') SEE NOTE #1	
	*Split Spoon Sampler Bouncing										BOTTOM OF BORING NOTE #1: LIMESTONE, HIGHLY WEATHERED AND BROKEN Brown to Yellow/Brown	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED 5-3-83	
BORING COMPLETED 5-3-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 10

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 589.02	pH
1	ST	24	5		20.3	18.3				586.5	FILL: SANDY SILT, BRICK CRUSHED STONE, AND CINDERS Dark Brown (2.5')	5.55
	HS								5		CLAYEY SILT, LITTLE SAND WITH NUMEROUS SAND LAYERS Gray/Brown	
2	ST	24	8		24.5	27.0	94	CL		582.5	(6.5')	6.57
	HS								10		SILTY SAND, FINE TO MEDIUM Gray Brown Very Loose to Loose	
3	SS	18	12	3	5.6	25.2		SM				7.19
	HS									575.2	(13.8')	
4	SS	6	4	166	1.9				15	574.0	SEE NOTE #1 (15.0')	7.04
									20		BOTTOM OF BORING	

NOTE #1:

LIMESTONE, WEATHERED AND BROKEN
Yellow Brown
Extremely Dense

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 6.0	W.S. OR W.D.		A.B.
W.L. 6.4	B.C.R.	7.0	A.C.R.
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	5-2-83
BORING COMPLETED	5-2-83
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 11

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 591.89	pH
										590.4	(1.0') TOPSOIL	
1	ST	24	7		40.0	34.7	76	CL				6.48
	HS										CLAYEY SILT, TRACE SAND OCCASIONAL SAND SEAMS Gray Coarse Sand and Gravel Layer @ 8.3-9.3	
2	ST	24	7		44.9	25.0	93	CL	5			7.40
	HS											
3	SS	18	10	16	20.4	29.9		CL / SM	10			7.22
	HS											
									15	576.8	(15.1')	
4	ST	24	5		21.9	26.8	89	CL			SILTY CLAY, TRACE SAND, TRACE WEATHERED LIME-STONE GRAVEL Gray	7.53
	HS								20			
5	ST	24	9		13.7	26.3	93	CL				7.12
										568.9	(23.0')	
	HS								25		SILTY CLAY, TRACE TO LITTLE SAND, TRACE GRAVEL Gray to Reddish Gray	
6	ST	24	10		24.3	27.4		CL				7.47
	HS								30			
7	ST	24	12		29.3	23.4	100	CL		560.4	(31.5')	6.93
											CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				Terracon Consultants, Inc.	BORING STARTED	5-6-83
W.L.	10.0 W.S. OR W.D.		A.B.	Cedar Falls Cedar Rapids Davenport	BORING COMPLETED	5-6-83
W.L.	6.7 B.C.R.	9.5	A.C.R.	Des Moines, IA Kansas City Wichita, KS	RIG Bomb	FOREMAN DEK
W.L.				Oklahoma City Tulsa, OK	APPROVED JFH	JOB # 783501

LOG OF BORING NO. I1 (CONTINUED)

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 591.89	pH
											CONTINUED FROM SHEET #2	
									60	532.4	(59.5')	
13	ST	24	14		12.4	20.8	104	CL				8.08
											(62.5')	
	HS										SILTY CLAY AND HIGHLY BROKEN, WEATHERED LIMESTONE	
						23.7			65			
14	ST	24	12		8.0	17.0		SC			Reddish Gray	7.99
	HS										Residual Zone Dense to Very Dense at 69.5	
									70			
15	SS	18	12	84	12.4	12.8		GC		520.9	(71.0')	
											LIMESTONE, HIGHLY WEATHERED Yellow Brown Very Dense	
									75	517.4	(74.5')	
											BOTTOM OF BORING	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	W.S. OR W.D.		A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED 5-6-83	
BORING COMPLETED 5-6-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 12

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	PROJECT NAME
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 590.87	pH
1	ST	24	6			40.9	72	OL		588.8	(2.0') SILT, LITTLE CLAY, TRACE SAND, Dark Brown, Topsoi	5.91
	HS										CLAYEY SILT, LITTLE SAND WITH OCCASIONAL SAND SEAMS Gray Brown	
2	ST	24	9		25.0	22.1	98	ML	5			6.18
	HS									582.3	(8.5')	
3	SS	18	16	26	2.8	24.6		SP-SM	10		SAND, FINE TO MEDIUM, TRACE SILT, TRACE LIME-STONE, TRACE LIMESTONE GRAVEL Brown Medium to Extremely Dense	6.33
	HS											
4	SS	18	18	84	2.6	10.2		SP-SM	15			7.42
	HS									571.8	(19.0')	
5	SS	18	18	16	13.1	31.9		CL	20		CLAYEY SILT, TRACE SAND AND SILTY CLAY, TRACE SAND Gray to Gray Brown Interbedded Occasional Silt Seams	7.34
	HS											
6	SS	18	13	30	18.9	30.9		CL	25			7.86
	HS											
7	ST	24	20	35.3	27.9	27.9	96	CL	30	559.8	(31.0')	8.13
											CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	14.0 W.S. OR W.D.		A.B.
W.L.	6.6	B.C.R.	A.C.R.
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	4-14-83
BORING COMPLETED	4-19-83
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 12 (Continued)

OWNER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.

ARCHITECT-ENGINEER

SITE
CLINTON, IOWA

PROJECT NAME
COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 590.87	pH
									30		CONTINUED FROM SHEET #1	
											(31.0')	
	HS										(34.0')	
8	ST	24	17		12.2	23.9	104	CL	35			7.91
	HS										CLAYEY SILT, TRACE SAND, WITH OCCASIONAL SILT SEAMS	
9	ST	24	18		40.7	25.7	98	CL	40		Gray to Reddish Gray/ Brown	7.51
	HS											
10	ST	24	21		17.8	24.1	103	CL	45			7.34
	HS											
11	ST	24	15		16.1	20.8	108	CL	50			7.77
	HS											
12	ST	24	15		8.3	22.7	105	CL	55			8.07
	HS										(59.0')	
									60		CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED 4-14-83	
BORING COMPLETED 4-19-83	
RIG Bomb	FOREMAN DEK
APPROVED JFH	JOB # 783501

LOG OF BORING NO. 12 (CONTINUED)

OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description SURFACE ELEVATION = 590.87	
										531.8	(59.0') CONTINUED FROM SHEET #2	
13	ST	24	16		16.1	22.1	103	CL	60			7.87
	HS											
14	ST	24	14		10.2	21.6	106	CL	65			8.19
	HS											
15	ST	24	13		17.6	22.0	105	CL	70		CLAYEY SILT, TRACE SAND, OCCASIONAL SILT SEAMS Gray Thin Sand Seams at 84.0 to 86.0	8.19
	HS											
16	ST	24	15		18.9	22.3	107	CL	75			8.22
	HS											
17	ST	24	12		27.2	25.5	103	CL	80			7.71
	HS											
18	ST	24	15		10.7	23.7	102	CL	85			8.11
	HS										(89.0')	
									90		CONTINUED	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED 4-14-83	
W.L.	W.S. OR W.D.	A.B.	Cedar Falls Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED 4-19-83	
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG Bomb	FOREMAN DEK
W.L.			Oklahoma City Tulsa, OK	APPROVED JFH	JOB # 783501

LOG OF BORING NO. 12 (CONTINUED)

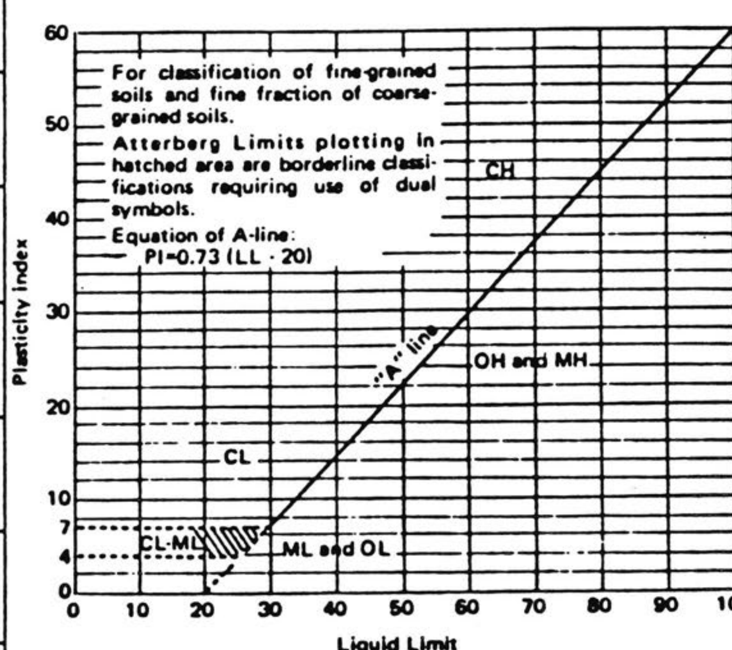
OWNER	ARCHITECT-ENGINEER
COLLIS/DIVISION OF CHAMBERLAIN MFG. CORP.	
SITE	**PROJECT NAME**
CLINTON, IOWA	COLLIS PHASED MONITORING PROGRAM

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description (SURFACE ELEVATION = 590.87)	pH
										501.8	(89.0') CONTINUED FROM SHEET #3	
									90			
19	ST	24	16		10.1	24.6	101	CL			CLAYEY SILT, TRACE SAND Gray Trace Limestone Gravel 94.0 to 96.0	8.04
	HS											
20	SS	18	16	62	15.6	24.6		CL	95			8.86
	HS											
						17.5	108	CL	100	491.2	(99.6')	
21	ST	24	15		17.4	15.0	113	SC			SILTY SAND AND LIMESTONE GRAVELS Gray to Brown Residual Zone Extremely Dense	8.49
22	SS	9	9	160	2.2	14.7		SM	105			7.18
23	SS	11	10	144	5.0	10.0		SM	110			8.18
24	SS	6	4	112	3.0	12.0		SM	115			8.25
											(117.5')	
25	SS	5	5	192	48.1	6.8					LIMESTONE, Brown (118.9') Highly Weathered	
									120		BOTTOM OF BORING	

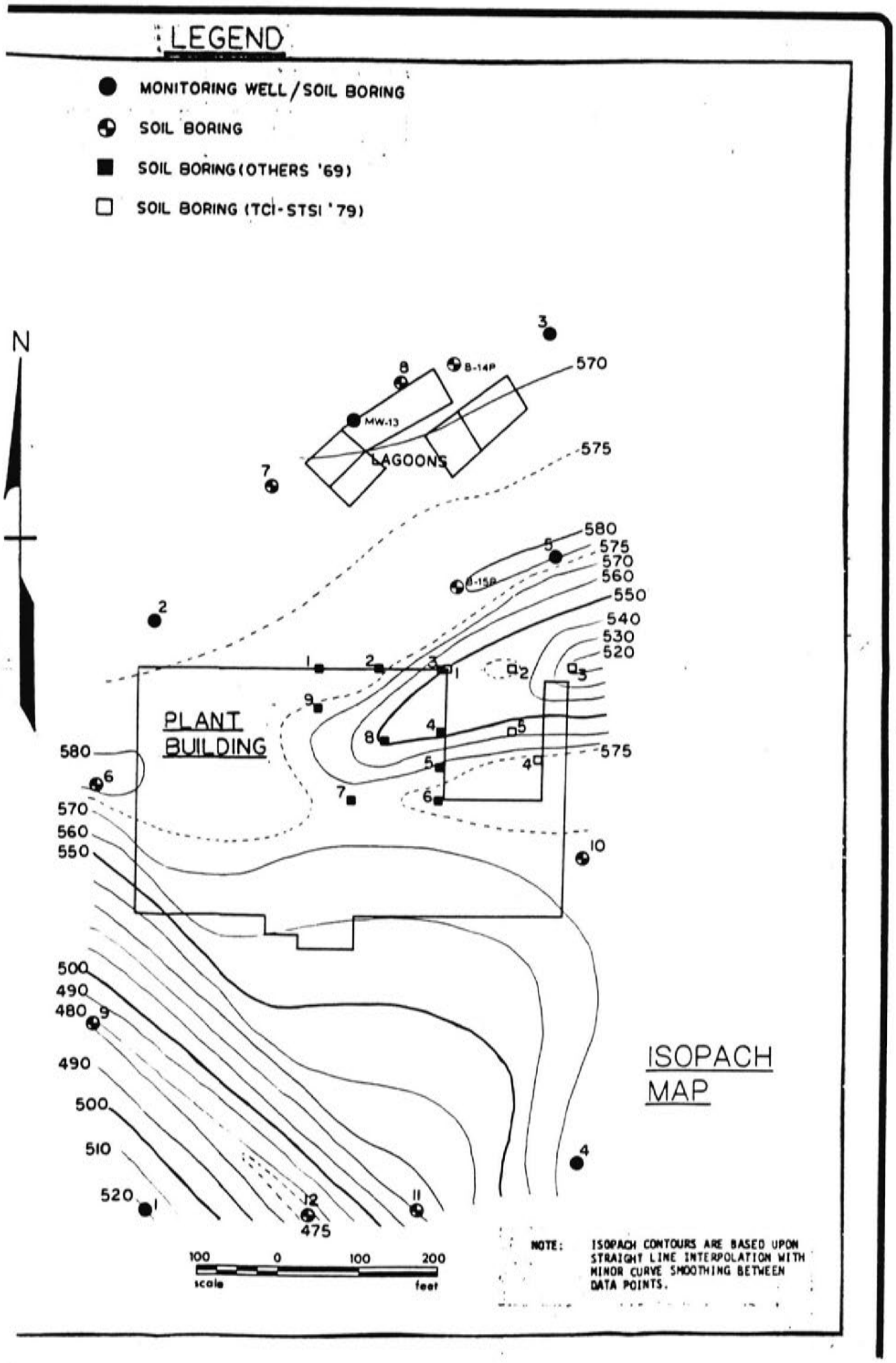
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED 4-14-83	
W.L.	W.S. OR W.D.	A.B.	Cedar Falls Cedar Rapids Davenport	BORING COMPLETED 4-19-83	
W.L.	B.C.R.	A.C.R.	Des Moines, IA Kansas City Wichita, KS	RIG Bomb	FOREMAN DEK
W.L.			Oklahoma City Tulsa, OK	APPROVED JFH	JOB # 783501

UNIFIED SOIL CLASSIFICATION SYSTEM

Major divisions			Group symbols	Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravels (More than half of coarse fraction larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent . . . . . GW, GP, SW, SP; More than 12 per cent . . . . . GM, GC, SM, SC; 5 to 12 per cent . . . . . *Borderline* cases requiring dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
Highly organic soils			Pt	Peat and other highly organic soils	Plasticity Chart		

TERRACON CONSULTANTS, INC.



NOTE: ISOPACH CONTOURS ARE BASED UPON STRAIGHT LINE INTERPOLATION WITH MINOR CURVE SMOOTHING BETWEEN DATA POINTS.

REVISIONS	BY
JUNE 21 1984 ADDED MW 13 & B14&15	JFH

ISOPACH MAP AND PROFILE LOCATION DIAGRAM

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORP. / COLLIS DIVISION
CLINTON, IOWA

TERRACON CONSULTANTS, INC.

DRAWN: JH / DSM
CHECKED: JOHN F HARTWELL
DATE: 8-10-83
SCALE: 1" = 100'
JOB NO. 783501
SHEET 2 OF 5 SHEETS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS	:	Split Spoon—1⅜" I.D., 2" O.D., unless otherwise noted
ST	:	Shelby Tube—2" O.D., unless otherwise noted
PA	:	Power Auger
HA	:	Hand Auger
DB	:	Diamond Bit—4 In, N, B
AS	:	Auger Sample
HS	:	Hollow Stem Auger
VS	:	Vane Shear
PS	:	Piston Sample
WS	:	Wash Sample
FT	:	Fish Tail
RB	:	Rock Bit
BS	:	Bulk Sample
PM	:	Pressuremeter
DC	:	Dutch Cone

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL	:	Water Level
WCI	:	Wet Cave In
DCI	:	Dry Cave In
AB	:	After Boring
WS	:	While Sampling
WD	:	While Drilling
BCR	:	Before Casing Removal
ACR	:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In low permeability soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence of ground water elevations must be sought.

DESCRIPTIVE SOIL CLASSIFICATION:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50 % of their dry weight retained on a #200 sieve; they are described as: clays, or clayey silts if they are cohesive, and silts if they are slightly cohesive or non-cohesive. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their consistency and plasticity. Example: Clayey silt, trace sand moderately plastic, stiff; silty fine sand, trace gravel, medium dense.

GRAIN SIZE TERMINOLOGY

Major Component Of Sample	Size Range
Boulders	Over 8 in. (200mm)
Cobbles	8 in. to 3 in. (200mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 2mm)
Sand	#4 to #200 sieve (2mm to .074mm)
Silt or Clay	Passing #200 sieve (0.074mm)

RELATIVE PROPORTIONS

Descriptive Term(s) (Of Components Also Present in Sample)	Percent of Dry Weight
Trace	1-10
Little	10-20
Some	20-35
And	35-50

RELATIVE DENSITY OF GRANULAR SOILS:

N-Blows/ft.	Relative Density
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
80 +	Extremely Dense

CONSISTENCY OF COHESIVE SOILS:

Unconfined Compressive Strength, Qu, psf	Consistency
◄ 500	Very Soft
500- 1,000	Soft
1,000- 2,000	Medium
2,000- 4,000	Stiff
4,000- 8,000	Very Stiff
8,000-16,000	Hard
► 16,000	Very Hard

PLASTICITY OF FINE GRAINED SOILS:

Term	Plasticity Index
None to slight	0- 3
Slight	4- 7
Moderate	8-25
High	► 25

LOG OF BORING NO. 13

OWNER	ARCHITECT-ENGINEER
Collis, Inc.	
SITE	**PROJECT NAME** Phase 1, Part 2
Clinton, Iowa	Hydrogeological Monitoring Program

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content %	Dry Density lbs/ft³	Unified Class Symbol
1	ST	24	12		44.0	31.5		
2	ST	24	7		23.7	20.0		
3	ST	24						
4	ST	24	8		20.4	22.1		
5	ST	24	6		37.5	29.1		
6	ST	24	6		36.1	17.4		
7	ST	24	17		24.9			CL
8	ST	24	16		11.0	24.1		CL
9	ST	24	15		23.4	24.3		CL
10	ST	24	15		22.4			CL
	HS							
11	SS	7	4		1.5			

Elevation	Description	pH
	Top of Pipe Elevation 591.1	
	Surface Elevation 588.3	
	FILL: CONCRETE, CINDERS, AND SILT-LITTLE CLAY, TRACE SAND, ROOTS & GRAVEL Dark Brown	6.76 6.97
582.3	6.0'	
	SANDY CLAYEY SILT Dark Brown (Possible fill)	6.48
578.3	10.0' (organics 8-10')	6.69
	SILTY CLAY-LITTLE SAND	6.24
576.3	12.0' Brown (Possible fill)	
	CLAYEY SILT-LITTLE SAND Gray to Red Gray	7.14 7.11
	(Occasional sand seams)	7.38
569.0	19.3'	6.88
	LIMESTONE HIGHLY WEATHERED	7.45
567.7	20.6' Brown	
	BOTTOM OF BORING	

Depth scale: 5, 10, 15, 20, 25

Well Construction notes

2" SCH 40 PVC well screen 10' long set to 20.0 feet.

Gravel pack 20.5 to 9.0 feet
Bentonite 9.0 to 1.2 feet
Cement Grout 1.2 to 0.0 feet
Steel protector pipe installed

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU THE TRANSITION MAY BE GRADUAL

WATER LEVEL OBSERVATIONS		
W.L. 3.0	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines Storm Lake, IA
Kansas City Wichita, KS
Omaha, NE
Oklahoma City Tulsa, OK

BORING STARTED 4-24-84	
BORING COMPLETED 4-24-84	
RIG BOMB	FOREMAN TAS
APPROVED JFH	JOB # 783606

LOG OF BORING NO. 14

OWNER
ollis, Inc.

SITE
Clinton, Iowa

ARCHITECT-ENGINEER

PROJECT NAME Phase 1, Part 2
Hydrogeological Monitoring Program

Top of Pipe Elevation 588.3
Surface Elevation 585.2

Sampl	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content %	Dry Density lbs/ft³	Unified Class Symbol	Depth	Elevation	Description	pH
1	ST	24	12		23.3	24.9		CL			FILL: SILT-LITTLE CLAY & SAND TRACE LIMESTONE GRAVEL Dark Gray	7.10
	HS											
2	ST	24	4.5		26.9	41.6		CL	5			7.09
	HS									576.2	9.0'	
3	ST	24	14		22.3	84.6		CL-OL	10		SILT-LITTLE CLAY, TRACE SAND Gray (organic)	7.11
	HS									570.7	14.5'	
4	ST	24	21		13.4	26.3		CL	15		SILT-LITTLE CLAY, TRACE SAND Gray	6.90
										566.2	19.0'	7.52
										565.6	19.6 SEE NOTE 1	
5	SS	1	1		6.1				20		BOTTOM OF BORING	

NOTE 1:
LIMESTONE-HIGHLY WEATHERED
Brown

Piezometer Point Construction Notes

2' long Piezometer point set to 19.5 feet; Gravel pack 19.5 to 8.0 feet; Bentonite 8.0 feet to 0.0 feet

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS

W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines Storm Lake, IA
Kansas City Wichita, KS
Omaha, NE
Oklahoma City Tulsa, OK

BORING STARTED 4-24-84
BORING COMPLETED 4-24-84
RIG BOMB FOREMAN TAS
APPROVED JFH JOB # 783606

LOG OF BORING NO. 15

OWNER	ARCHITECT-ENGINEER
llis, Inc.	
SITE	PROJECT NAME Phase 1, Part 2
Clinton, Iowa	Hydrogeological Monitoring Program

Sample	Type Sample	Sampling Distance	Recovery	Blows/ft.	Cation Exchange Capacity	Water Content %	Dry Density lbs/ft³	Unified Class Symbol	Depth	Elevation	Description Top of Pipe Elevation 589.6 Surface Elevation 587.4	pH
											SEE NOTE 1	
1	ST	24	7		8.5	18.4		SM				7.75
										583.9	3.5	
	HS										SILTY CLAY TRACE SAND WITH OCCASIONAL SAND SEAMS	
					11.1	31.3			5			7.15
	SS	18			25.6	16.1		CL			Dark Gray	
										579.9	7.5'	6.41
	HS											
	~~SS~~	~~6~~		~~60/6"~~	~~1.8~~	~~7.8~~				578.8	(8.5) LIMESTONE-HIGHLY WEATHERED	6.07
											BOTTOM OF BORING	
									10			

NOTE 1:
FILL SILTY SAND WITH GRAVEL & CINDERS
Dark Gray and Brown
Oil observed from .5 to 3.5 ft.

Piezometer Point Construction Notes

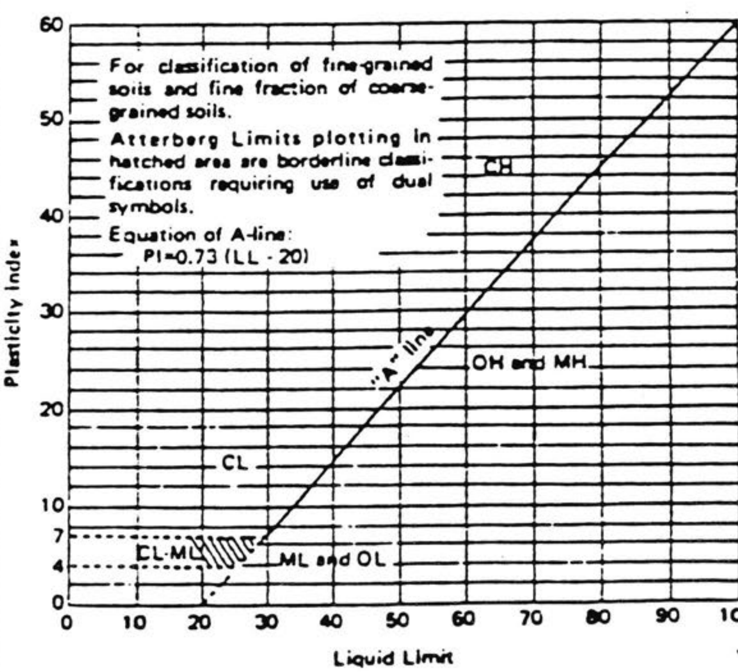
2' Piezometer point set at 8.5'
Gravel pack 8.5 to 5.0'
Bentonite 5.0 to 0.0'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				Terracon Consultants, Inc.	BORING STARTED 4-25-84	
W.L.	6	W.S. OR W.D.	A.B.	Cedar Falls Cedar Rapids Davenport	BORING COMPLETED 4-25-84	
W.L.		B.C.R.	A.C.R.	Des Moines Storm Lake, IA Kansas City Wichita, KS	RIG BOMB	FOREMAN TAS
W.L.				Omaha, NE Oklahoma City Tulsa, OK	APPROVED JFH	JOB # 783606

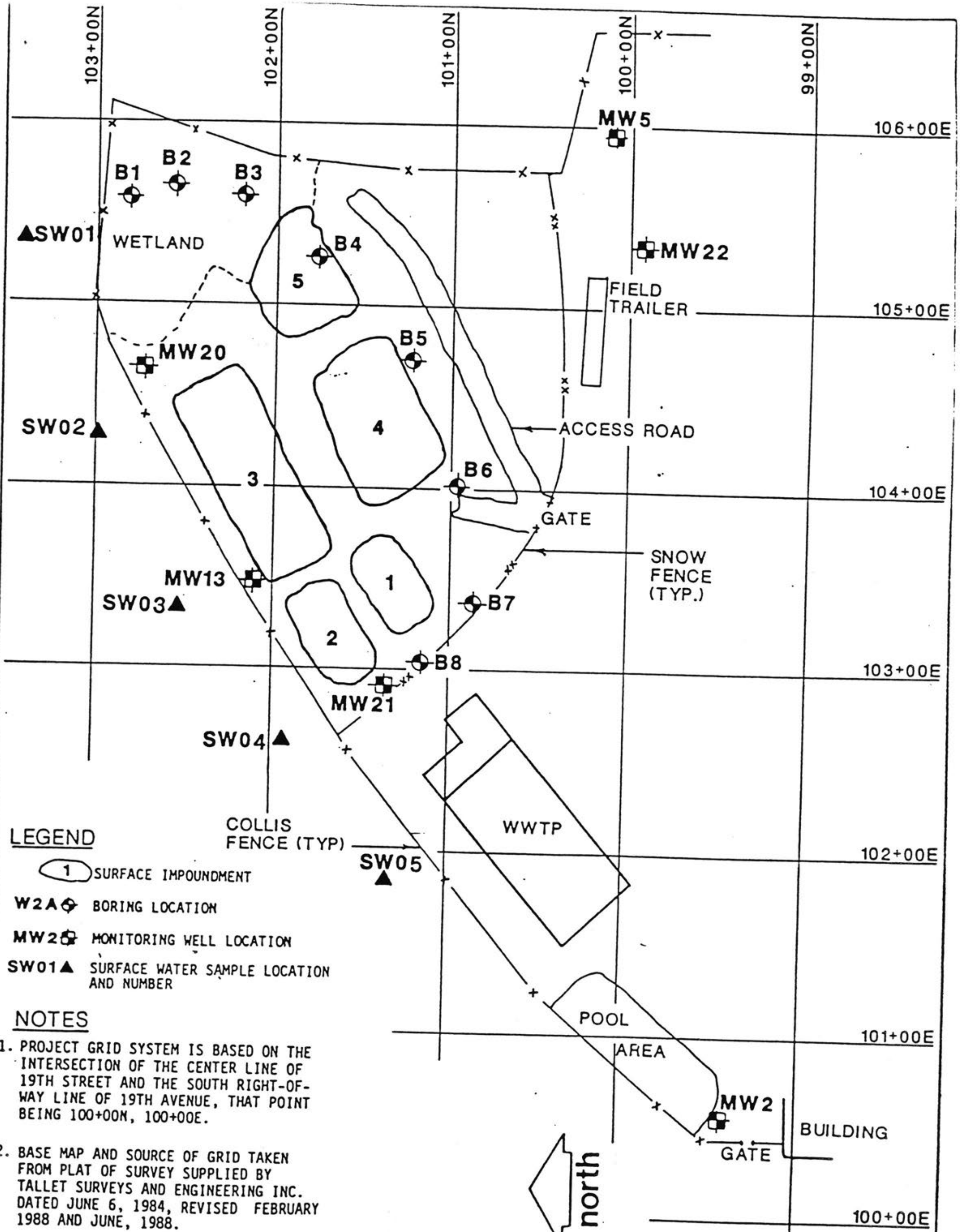
UNIFIED SOIL CLASSIFICATION SYSTEM

Major divisions			Group symbols	Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 per cent . . . . GW, GP, SW, SP; More than 12 per cent . . . . GM, GC, SM, SC; 5 to 12 per cent . . . . *Borderline* cases requiring dual symbols	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half of material is smaller than No. 200 sieve size)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
Highly organic soils			Pt	Peat and other highly organic soils			



Plasticity Chart

TERRACON CONSULTANTS, INC.



LEGEND

(1) SURFACE IMPOUNDMENT

W2A BORING LOCATION

MW2 MONITORING WELL LOCATION

SW01 SURFACE WATER SAMPLE LOCATION AND NUMBER

NOTES

1. PROJECT GRID SYSTEM IS BASED ON THE INTERSECTION OF THE CENTER LINE OF 19TH STREET AND THE SOUTH RIGHT-OF-WAY LINE OF 19TH AVENUE, THAT POINT BEING 100+00N, 100+00E.

2. BASE MAP AND SOURCE OF GRID TAKEN FROM PLAT OF SURVEY SUPPLIED BY TALLET SURVEYS AND ENGINEERING INC. DATED JUNE 6, 1984, REVISED FEBRUARY 1988 AND JUNE, 1988.

3. LOCATIONS OF MANUFACTURERS DITCH SURFACE WATER SAMPLES ARE APPROXIMATE.

APPROXIMATE SCALE: 1"=70'

WARZYN

SOIL BORING AND MONITORING WELL LOCATION MAP
COLLIS, INC.
CLINTON, IOWA

DWN JC	APP'D DJD	DATE 7-8-88	60123-A3

WARZYN

LOG OF TEST BORING

Project: Collis Inc.

Location: Clinton, Iowa

Boring No. MW-20
Surface Elevation 588.0
Job No. 60123
Sheet 1 of 1

ONE SCIENCE COURT · P.O. BOX 5385, MADISON, WIS. 53705 · TEL.(608) 273-0440

SAMPLE No.	Type	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monoto
1		21	M	14		BERM FILL: Brown Sandy, Silty Clay, Trace Roots, Trace Gravel		0.0			
2		23	M	10		FILL: Brown Organic Rich Clay and Peat, Little Roots, Occasional Cinders, Glass Fragments, Red Brick Fragments, Gravel, Wood/Organic Fibers		0.0			
3		15	M/W	2	5			0.0			
4		15	W	2		Possible FILL: Brown Organic Rich Clayey Topsoil to Peat, Little Roots, Some Wood/Fibers		0.0			
5			W	0				0.0			
					10	End Boring at 9' Monitoring well installed. See separate detail sheet.					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ___ Upon Completion of Drilling ___
Time After Drilling ___
Depth to Water ___
Depth to Cave in ___

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 2/2/88 End 2/2/88
Driller ___ Chief RK Rig CME 750
Logger ___ Editor ___
Drill Method 6 1/4" ID HSA

WARZYN

LOG OF TEST BORING

Project: Collis Inc.

Location: Clinton, Iowa

Boring No. MW-21
Surface Elevation 587.1
Job No. 60123
Sheet 1 of 1

ONE SCIENCE COURT · P.O. BOX 5385, MADISON, WIS. 53705 · TEL.(608) 273-0440

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monoto
1		18	D/M	6		FILL: Black Organic-Rich Sandy Clay, Trace to Little Roots/Organic Fibers, Little Medium to Coarse Gravel, Cinders, Red Brick Fragments, Occasional 1-2" Sand Layers		0.0			
2		21	M	6				0.0			
3		10	M	2	5	Soft Green-Gray Silty CLAY, Trace Organics/Roots, Some Black Organic Stain (CL)		0.0			
4		10	W	1		Soft, Brown Sandy CLAY, Some Organic Fibers, Frequent Sandy Partings and 1" Layers of Sand		0.0			
5		10	W	1		Weathered LIMESTONE Bedrock					
					10	End Boring at 9.5'					
						Monitoring well installed. See separate detail sheet.					
					15						
					20						

WATER LEVEL OBSERVATIONS

While Drilling ∇		Upon Completion of Drilling		
Time After Drilling				
Depth to Water				
Depth to Cave in				

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 2/4/88 End 2/4/88
Driller ______ Chief RK Rig CME 750
Logger ______ Editor ______
Drill Method 6 1/4" ID HSA

WARZYN

LOG OF TEST BORING

Project: Collis Inc.

Location: Clinton, Iowa

Boring No. MW-22
Surface Elevation 588.8
Job No. 60123
Sheet 1 of 1

ONE SCIENCE COURT · P.O. BOX 5385, MADISON, WIS. 53705 · TEL.(608) 273-0440

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth		qu (qa) (tsf)	HNu	Explosive Gas	Field VOC Water	Monoto
1		21	D/M	41		FILL: Medium to Coarse Gravel, Some Fine to Coarse Sand, Some Weathering of Stones (Mostly Carbonate, Occasional Siliceous Grains), Some Black Organic Stain, Occasional Cinder, Angular to Subangular		0.0			
2		22	M	20				0.0			
3		19	M	5	5	Black Organic Rich Clayey TOPSOIL, Trace Roots, Frequent Sandy Partings (Fill)		0.0			
4		12	W	0		FILL: Gray & Red Mottled Clay, Little to Some Sand, Alternating with Very Soft Red/Pink Sandy, Silty Clay (3-6" Layers), Some Wood Fibers/Organic Matter, Little Black Organic Stain		0.0			
5		14	W	118				0.0			
					10	Weathered LIMESTONE Bedrock					

End Boring at 8.5'

Advance rig 6', blind drill to 7.5'. Set monitoring well at 7'. See separate detail sheet.

15

20

WATER LEVEL OBSERVATIONS

While Drilling ∇ ______ Upon Completion of Drilling ______
Time After Drilling
Depth to Water
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start 2/2/88 End 2/2/88
Driller ______ Chief RK Rig CME 750
Logger ______ Editor ______
Drill Method 6 1/4" ID HSA

ATTACHMENT 3

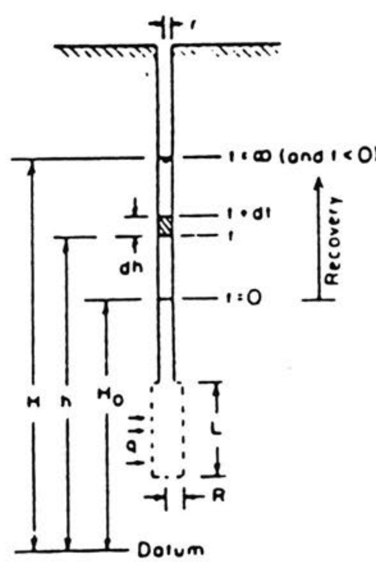
SLUG TEST PROCEDURE AND RESULTS

Bailing Tests

Bailing tests were conducted on the five monitoring wells installed. The tests were performed four days after the initial well purging, and initial static water levels used for determination of hydraulic conductivity were those measured just prior to the second round of purging. In this test, the water is bailed from the well to achieve a measurable amount of drawdown within the well casing, and the rate of recharge is then measured immediately following the withdrawal of the final bailed volume. This initial rate of recharge is used to approximate the original rate of inflow into the well, and an average horizontal hydraulic conductivity is calculated using a method presented by Hvorslev in 1951 for a point piezometer in a unconfined aquifer, using the following equation:

$$K = \frac{r^2 \ln (L/R)\ (2.54\ \text{cm/in})}{2LT_o} \qquad \text{Where } T_o = V/q_o$$

$q_o = (f)\pi r^2$ = Flow Rate
$V = \pi r^2 (H-H_o)$ = Volume of Water Removed
L = Length of Saturated Annulus Below the Bentonite Seal
r = 1.03 in.
R = 3.13 in.



The results of these field tests are presented in Table No. 4 of Appendix 1.

Water Level Monitoring

Groundwater level observations were made by Terracon personnel on several

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORPORATION
COLLIS DIVISION, CLINTON, IOWA

Job No. 783501 September 12, 1983

TABLE NO. 4 - SLUG-OUT TEST RESULTS - MAY 16, 1983

Well Number	L (ft.)	H* Elev. (ft.)	H_i Elev. (ft.)	H_o Elev. (ft.)	$\frac{H-h}{H-H_o}$	t_i (hr.)	T_o (hr.)	$\frac{r^2 \ln(L/R)}{2L}$ (in.)	K (cm/sec)
MW-1	12.4	584.2	528.4	525.6	.9522	.85	31	.0138	3.1×10^{-7}
MW-2	9	584.8	569.2	568.9	.9811	.10	13	.0174	9.4×10^{-7}
			569.4	568.9	.9686	.20			
MW-3	14.8	584.5	567.3	566.9	.9773	.233	18	.0121	4.7×10^{-7}
MW-4**	11.2	588.7	580.1	578.7	.8600	.050	.22	.0148	4.7×10^{-5}
			587.0	578.2	.1619	.233			
MW-5**	5.2	585.2	584.6	582.2	.2000	.0833	.06	.0254	3.0×10^{-4}
			584.4	581.4	.2105	.1167			

NOTES

H = Initial Static Water Level Elevation

h_i = Water Level Elevation at t_i

H_o = Initial Water Level Elevation (Following Bailing)

K = Hydraulic Conductivity

L = Length of Screened/Gravel-Packed Interval

r = Inside Radius of Well = 1.03 in.

R = Bore Hole Radius = 3.13 in.

t_i = Elapsed Time

T_o = Graphical Solution = $\frac{H-h}{H-H_o}$ = 0.37 hr.

* Determined from long-term level obtained May 16, 1983.

** Wells penetrate into limestone bedrock.

- potentiometric contour maps (1988 data)

ATTACHMENT 4

GROUNDWATER ELEVATIONS
AND
POTENTIOMETRIC CONTOUR MAPS

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORPORATION
COLLIS DIVISION, CLINTON, IOWA

Job No. 783501 September 12, 1983

TABLE NO. 5 - WATER LEVEL RECORDS

Date (1983)		5-12	5-16	5-17	5-31	6-20	8-12			
Point Designation	Top of Pipe Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.	Elev.
MW-1P	589.2	---	583.7	583.5	---	---	---			
MW-1	590.5	585.1	584.2	567.7	586.3	585.6	587.4			
MW-2	590.2	584.4	584.8	584.5	584.7	584.7	584.0			
MW-3	587.2	584.3	584.5	584.5	584.5	584.5	582.5			
MW-4	596.0	588.6	588.7	588.5	---	588.5	586.3			
MW-5	590.2	584.7	585.2	585.1	585.2	584.7	584.6			
B-6P	588.4	---	583.8	584.1	---	---	583.2			
B-7P	589.4	---	585.0	585.1	---	---	584.2			
B-9PA	588.9	---	583.1	583.2	---	---	581.5			
B-9PB	588.9	---	588.0	588.0	---	---	587.1			
B-10P	589.5	---	585.4	585.3	---	---	583.4			
B-11P	592.4	---	588.2	588.1	---	---	584.5			

--- Indicates reading not taken.

Elevations are in feet.

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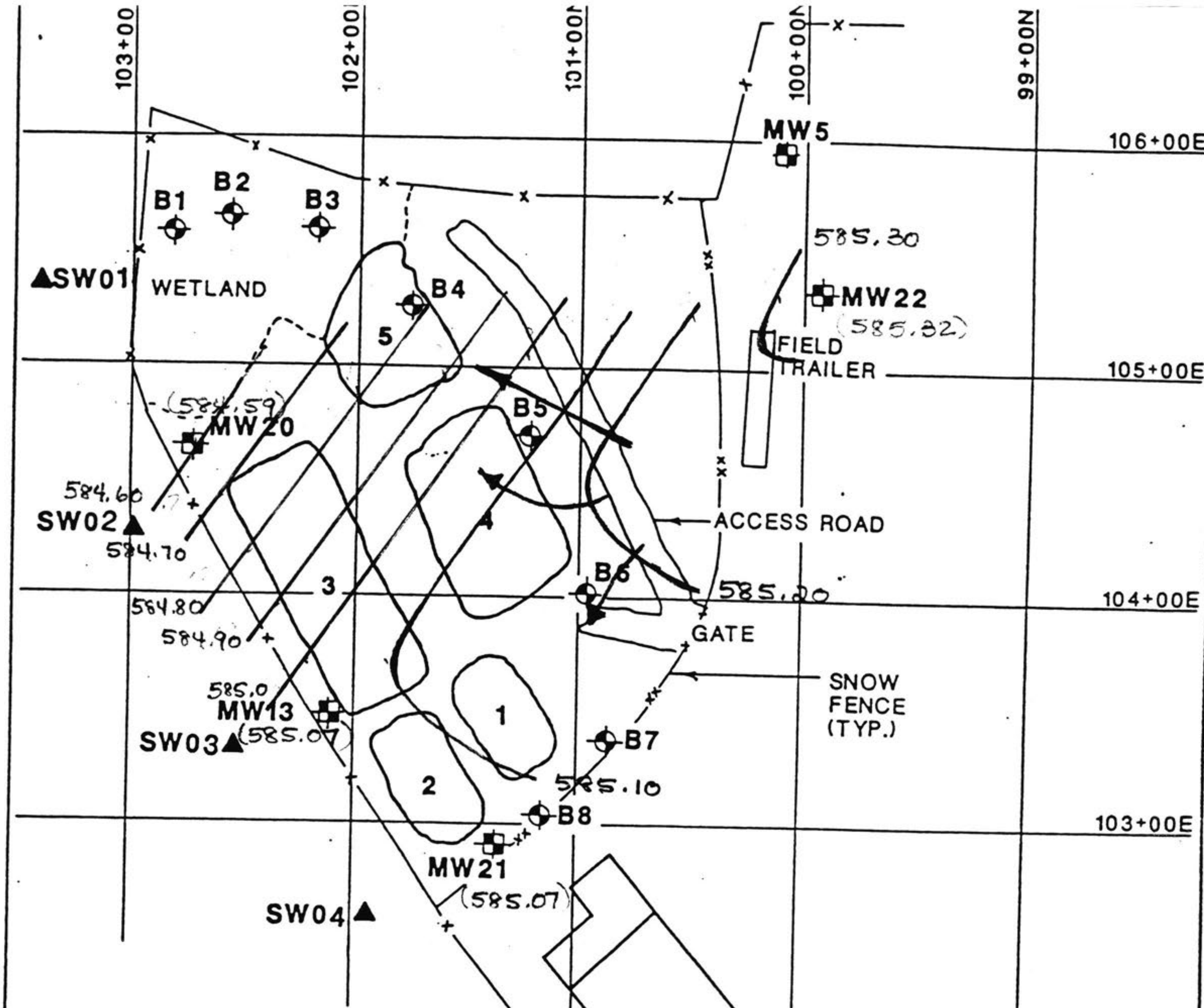
WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 03/18/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 5-16-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.33	585.07
MW-20	590.07	5.48	584.59
MW-21	588.94	3.87	585.07
MW-22	590.24	4.92	585.32



LEGEND

(1) SURFACE IMPOUNDMENT

W2A BORING LOCATION

MW2 MONITORING WELL LOCATION

SW01▲ SURFACE WATER SAMPLE LOCATION AND NUMBER

NOTES

1. PROJECT GRID SYSTEM IS BASED ON THE INTERSECTION OF THE CENTER LINE OF 19TH STREET AND THE SOUTH RIGHT-OF-WAY LINE OF 19TH AVENUE, THAT POINT BEING 100+00N, 100+00E.

2. BASE MAP AND SOURCE OF GRID TAKEN FROM PLAT OF SURVEY SUPPLIED BY TALLET SURVEYS AND ENGINEERING INC. DATED JUNE 6, 1984, REVISED FEBRUARY 1988 AND JUNE, 1988.

3. LOCATIONS OF MANUFACTURERS DITCH SURFACE WATER SAMPLES ARE APPROXIMATE.

APPROXIMATE SCALE: 1"=70'

DWN JC	APP'D DJD	DATE 7-8-88	60123-A3	WARZYN	SOIL BORING AND MONITORING WELL LOCATION MAP COLLIS, INC. CLINTON, IOWA

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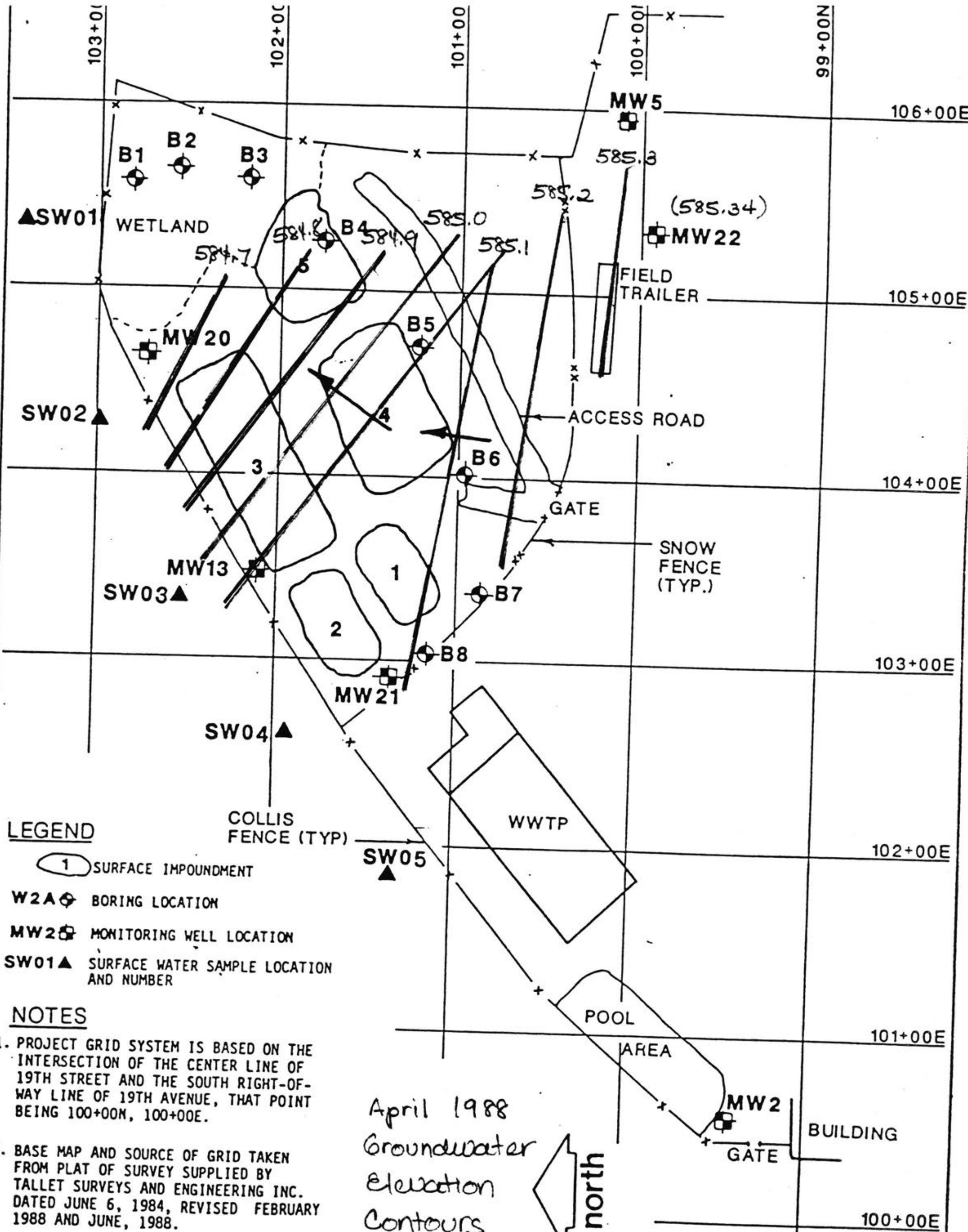
WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 5-16-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.30	585.10
MW-20	590.07	5.45	584.62
MW-21	588.94	3.86	585.08
MW-22	590.24	4.90	585.34



LEGEND

(1) SURFACE IMPOUNDMENT

W2A BORING LOCATION

MW2 MONITORING WELL LOCATION

SW01 SURFACE WATER SAMPLE LOCATION AND NUMBER

NOTES

1. PROJECT GRID SYSTEM IS BASED ON THE INTERSECTION OF THE CENTER LINE OF 19TH STREET AND THE SOUTH RIGHT-OF-WAY LINE OF 19TH AVENUE, THAT POINT BEING 100+00N, 100+00E.

2. BASE MAP AND SOURCE OF GRID TAKEN FROM PLAT OF SURVEY SUPPLIED BY TALLET SURVEYS AND ENGINEERING INC. DATED JUNE 6, 1984, REVISED FEBRUARY 1988 AND JUNE, 1988.

3. LOCATIONS OF MANUFACTURERS DITCH SURFACE WATER SAMPLES ARE APPROXIMATE.

APPROXIMATE SCALE: 1"=70'

WARZYN

SOIL BORING AND MONITORING WELL LOCATION MAP
COLLIS, INC.
CLINTON, IOWA

DWN JC	APP'D DJD	DATE 7-8-88	60123-A3

WARZYN

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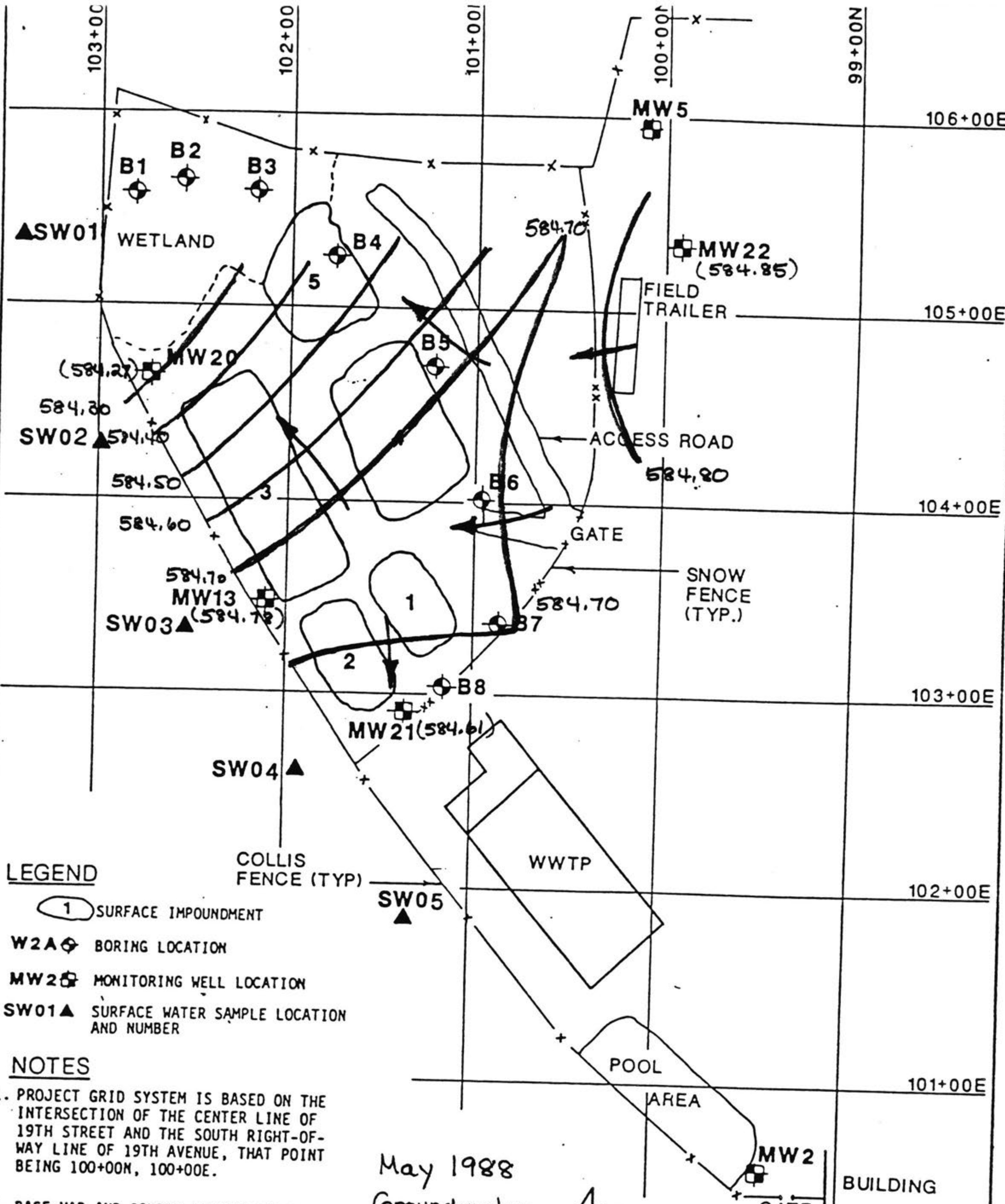
WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 7-14-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.62	584.78
MW-20	590.07	5.80	584.27
MW-21	588.94	4.33	584.61
MW-22	590.24	5.39	584.85



NOTES

1. PROJECT GRID SYSTEM IS BASED ON THE INTERSECTION OF THE CENTER LINE OF 19TH STREET AND THE SOUTH RIGHT-OF-WAY LINE OF 19TH AVENUE, THAT POINT BEING 100+00N, 100+00E.
2. BASE MAP AND SOURCE OF GRID TAKEN FROM PLAT OF SURVEY SUPPLIED BY TALLET SURVEYS AND ENGINEERING INC. DATED JUNE 6, 1984, REVISED FEBRUARY 1988 AND JUNE, 1988.
3. LOCATIONS OF MANUFACTURERS DITCH SURFACE WATER SAMPLES ARE APPROXIMATE.

APPROXIMATE SCALE: 1"=70'

WARZYN

SOIL BORING AND MONITORING WELL LOCATION MAP
COLLIS, INC.
CLINTON, IOWA

DWN JC	APP'D DJD	DATE 7-8-88	60123-A3

WARZYN ENGINEERING INC. • ONE SCIENCE COURT • UNIVERSITY RESEARCH PARK • P.O. BOX 5385 • MADISON, WISCONSIN 53705 • (608) 273 0440

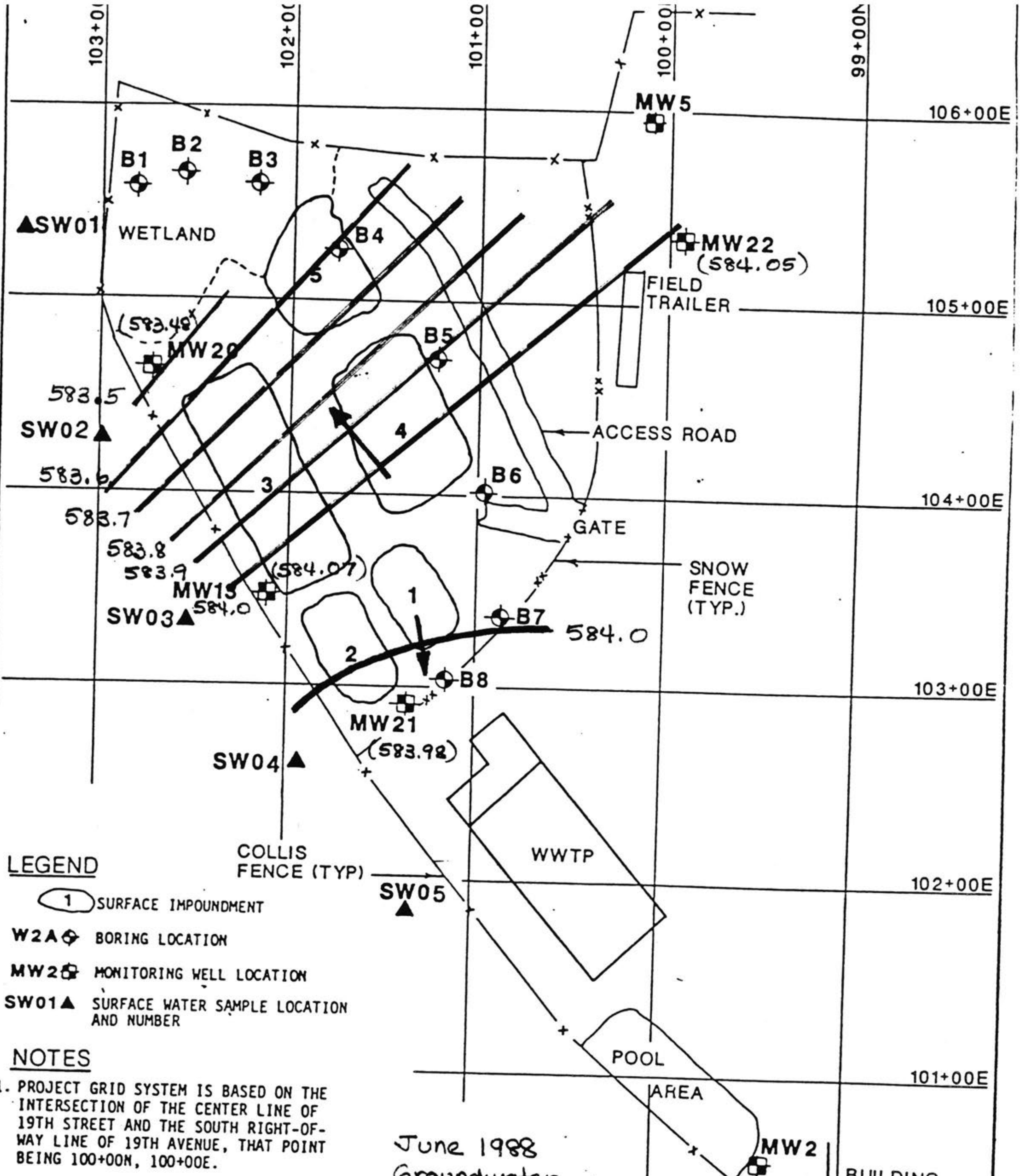
WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 6-9-88
SAMPLED BY: GFP
CK'D: LSS APP'D: DJO
DATE ISSUED: 7-14-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	7.33	584.07
MW-20	590.07	6.59	583.48
MW-21	588.94	4.96	583.98
MW-22	590.24	6.19	584.05



LEGEND

(1) SURFACE IMPOUNDMENT

W2A BORING LOCATION

MW2 MONITORING WELL LOCATION

SW01 SURFACE WATER SAMPLE LOCATION AND NUMBER

NOTES

1. PROJECT GRID SYSTEM IS BASED ON THE INTERSECTION OF THE CENTER LINE OF 19TH STREET AND THE SOUTH RIGHT-OF-WAY LINE OF 19TH AVENUE, THAT POINT BEING 100+00N, 100+00E.
2. BASE MAP AND SOURCE OF GRID TAKEN FROM PLAT OF SURVEY SUPPLIED BY TALLET SURVEYS AND ENGINEERING INC. DATED JUNE 6, 1984, REVISED FEBRUARY 1988 AND JUNE, 1988.
3. LOCATIONS OF MANUFACTURERS DITCH SURFACE WATER SAMPLES ARE APPROXIMATE.

APPROXIMATE SCALE: 1"=70'

WARZYN

SOIL BORING AND MONITORING WELL LOCATION MAP
COLLIS, INC.
CLINTON, IOWA

DWN JC	APP'D DJD	DATE 7-8-88	60123-A3

ATTACHMENT 5

MONITORING WELL AND PIEZOMETER CONSTRUCTION DETAILS

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORPORATION
COLLIS DIVISION, CLINTON, IOWA

Job No. 783501 September 12, 1983

TABLE NO. 1 - SAMPLING POINT COORDINATES

Point	Base Line Reference		Elevations*	
	N - S (ft.)	E - W (ft.)	Natural Ground (ft.)	Top of Pipe (ft.)
MW-1 MW-1P	N8.1	E73.1	588.52	590.5 (P)589.2
MW-2	N743.7	E80.2	587.75	590.2
MW-3	N1100.8	E572.6	584.45	587.2
MW-4	N65	E612	594.27	596.0
MW-5	N823.1	E582.7	586.41	590.2
B-6P	N535.6	E9.2	587.90	(P)588.4
B-7P	N910.3	E228.6	586.40	(P)589.4
B-8	N1038.7	E388.3	588.48	-----
B-9PA B-9PB	N241.0	E5.0	588.38	(PA)588.9 (PB)588.9
B-10P	N440.3	E616.0	589.02	(P)589.5
B-11P	N9.0	E412.8	591.89	(P)592.4
B-12	N3.3	E277.3	590.87	-----
SSS-1	N1037.9	E523.6	586.36	-----
SSS-2	N954.4	E284.7	588.60	-----
SSS-3	N1008.9	E453.2	587.72	-----
SSS-4	N926.0	E457.3	587.26	-----
SSS-5	N892.2	E323.2	587.56	-----
SSS-6	N38.1	E148.1	-----	-----
SWS-1	N1254.3	E672.3	579.77[a]	-----
SWS-2	N380.8	W275	-----	-----
SWR-1	N863.4	E368.4	587.26	-----
BM-1*	N826	E 0	587.22*	-----
BM-2	N303	E 0	590.57	-----

a = Water level on 4-13-83.

* = Elevations referenced to City of Clinton Bench Mark #1 - monument pin inset in east abutment of South 19th Street Bridge.

(P) = Piezometer point.

PHASED MONITORING PROGRAM
CHAMBERLAIN MANUFACTURING CORPORATION
COLLIS DIVISION, CLINTON, IOWA

Job No. 783501

September 12, 1983

TABLE NO. 2 - MONITORING POINT INSTALLATION RECORD

Point Designation	Date Installed	Top of Pipe Elev. (ft.)	Bottom of Screen		Screen Length/ Type**	Depth Range(ft.)*		Prot. Pipe	Well Marking
			Elevation (ft.)	Depth* (ft.)		Gravel Pack	Seal/ Type**		
[redacted]	4-21-83	589.2	578.7	9.8	.5/P	9.8-2.5	2.5-0/B	No	PIEZ
MW-1	4-21-83	590.5	[redacted]	68.5	10/S	69.4-57.0	57.0-0/G	Yes	B1MW
MW-2	4-27-83	590.2	[redacted]	19.7	5/S	21.5-12.5	12.5-10.8/B 10.8-2.5/G	Yes	B2MW
MW-3	4-28-83	587.2	[redacted]	19.3	10/S	19.3-4.5	4.5-2.0/B 2.0-0.0/G	Yes	B3MW
MW-4	4-20-83	596.0	[redacted]	16.8	10/S	19.2-6.6	6.6-2.2/B 2.2-0/G	Yes	B4MW
MW-5	4-28-83	590.2	[redacted]	6.5	5/S	6.7-0.9	0.9-0.3/B 0.3-0/G	Yes	B5MW
[redacted]	5-3-83	588.2	574.7	13.0	.5/P	15.3-9.0	9.0-1.5/B 1.5-0/G	No	PIEZ
[redacted]	5-2-83	589.4	571.9	14.5	.5/P	15.4-10.7	10.7-9.2/B 9.2-0/G	No	PIEZ
B-8	4-29-83	N/A	---	---	---	---	24.0-0/G	---	---

PHASED MONITORING PROGRAM

CHAMBERLAIN MANUFACTURING CORPORATION

COLLIS DIVISION, CLINTON, IOWA

Job No. 783501

September 12, 1983

TABLE NO. 2 - MONITORING POINT INSTALLATION RECORD

Point Designation	Date Installed	Top of Pipe Elev. (ft.)	Bottom of Screen Elevation (ft.)	Bottom of Screen Depth* (ft.)	Screen Length/ Type**	Depth Range(ft.)* Gravel Pack	Depth Range(ft.)* Seal/ Type**	Prot. Pipe	Well Marking
B-9PA	5-5-83	588.9	573.4	15.0	.5/P	15-12	12-3/B 3-0/G	No	A
B-9PB	5-5-83	588.9	478.4	110.0	.5/P	110-104	104-96/B 96-0/G	No	B
B-10P	5-2-83	589.5	574.9	14.1	.5/P	15.0-6.7	6.7-2/B 2-0/G	No	PIEZ
B-11P	5-6-83	592.4	579.9	12.0	.5/P	15.0-2	2-0/B	No	PIEZ***
B-11	5-6-83	N/A	---	---	---	---	74.5-0/G	---	---
B-12	4-19-83	N/A	---	---	---	---	118.9-2/B	---	---

* All depths referenced to ground surface.

** B = Bentonite.

G = 6 Parts Cement to 1 Part Bentonite Grout.

P = Piezometer Point.

S = Manufactured PVC Well Screen.

*** B-11P is 2 feet east of B-11.

ATTACHMENT 6

JACOBS ENGINEERING GROUP QA/QC AUDIT OBSERVATIONS

TABLE 1
COLLIS QA/QC FIELD AUDIT
August 10, 1988
Pre-Sampling Evaluation

Construction Details/ Field Measurements	MONITORING WELLS MW-13	MW-20	MW-21	MW-22
CONSTRUCTION DETAILS:				
Location	Downgradient	Downgradient	Downgradient	Upgradient
Reference Point	10.5' S. of Fence	8' S. of Utility pole	19.6' SSE of Utility pole	W. of MW-5 among pallets
As Indicated on Map	Further W.	Further SE	Further S.	Further SW.
Diameter	2"	2"	2"	2"
Construction Materials	Sch. 40 PVC	Sch. 40 PVC	Sch. 40 PVC	Sch. 40 PVC
Locking Mechanism	Steel Outer Casing Locking hinged Cap	Steel Outer Casing Locking hinged Cap	Steel Outer Casing Locking hinged Cap	Steel Outer Casing Locking hinged Cap
Surface Seal	Cement Apron	Cement Apron	Cement Apron	Cement Apron
Stick up	34.5"	26.0"	23.0"	17.0"
PRE-SAMPLING MEASUREMENTS:				
Total Depth (feet)**	22.6'	11.6'	10.02'	8.75'
Sediment Thickness	None	None	None	None
Depth to Water	8.48'	8.01'	6.19'	6.93'
Measuring Device	Water Level Indicator	Water Level Indicator	Water Level Indicator	Water Level Indicator
Decontamination*				
Immiscible Layer	Not Measured	Not Measured	Not Measured	Not Measured
Measuring Device	NA	NA	NA	NA
3-5 Well Volumes	No	No	Yes	Yes
Calculation Technique** pi x r2 x (TD - DTW) x gal/ft3				
Well Vol. Evacuated	1.09	0.86 - 1.29	3.97	3.3

TABLE 1
COLLIS QA/QC FIELD AUDIT
August 10, 1988
Pre-Sampling Evaluation

Construction Details/ Field Measurements	MONITORING WELLS MW-13	MW-20	MW-21	MW-22
Evacuation Equipment	ded. PVC Bailer	SS Bailer	SS Bailer	SS Bailer
Dedicated/non-Dedicated	Yes	No	No	No
Delivery Line Materials	nylon cord in well	Steel filament	Steel filament	Steel filament
Intake Position	Mid to Bottom	Bottom	Bottom	Bottom
Mgmt of Purged Water	Disch. to ground	Disch. to ground	Disch. to ground	Disch. to ground
Color	Clear	Black to Dr. Gray	Slightly Cloudy	Cloudy
Odor	None	None	None	None
Turbidity	Low	High	Moderate	Moderate
Oil and Grease	None	None	None	None

* Decontamination: Alconox wash
Potable Water Rinse
Deionized Water Rinse

** Well completion diagrams not available to confirm total depth.

TABLE 2
Collis QA/QC Field Audit
Groundwater Sampling

Construction Details/ Field Measurements	MONITORING WELLS MW-13	MW-20	MW-21	MW-22
Water Level Recovery	Full	Incomplete	Incomplete	Incomplete
Sampling Device	SS Bailer	SS Bailer	SS Bailer	SS Bailer
Dedicated/non-Dedicated	Yes-kept in well	Yes	No	No
Delivery Line Materials	Steel Filament	Steel Filament	Steel Filament	Steel Filament
Intake Position	Middle to Bottom	Bottom	Bottom	Bottom
Decontamination*				
Color	Clear	NS	Clear	Clear
Odor	None	NS	None	None
Turbidity	Low	NS	Low	Low
Oil and Grease	None	NS	None	None
pH	(Q) 7.2/7.2/7.2/7.2 (F) 7.3 (W) 7.2	NS	(Q) 6.5	(Q) 7.0
Conductivity	650/650/650/650 600 800	NS	2000	2800
Temperature	19/22/22/22 15 24	NS	18	20
Other: Redox	NM	NS	NM	NM
Dissolved Oxygen	NM	NS	NM	NM
Turbidity	NM	NS	NM	NM
Sampling Sequence	2	NS	3	1

NS = Not Sampled; NM = Not Measured

* Decontamination: Alconox wash
Potable Water Rinse
Deionized Water Rinse

(Q) = Quadruplicate Audit Measurements
(F) = Final Measurement at Conclusion of Sampling
(W) = Warzyn's Field Measurement

TABLE 3
SAMPLE COLLECTION SUMMARY

PARAMETER	MW-13		MW-20		MW-21		MW-22	
	Warzyn	Jacobs	Warzyn	Jacobs	Warzyn	Jacobs	Warzyn	Jacobs
TOX (Q)	1	3 (1 br) 1 (dup)	NS	NS	1	4	1	1 (3NS)
TOC (Q)	1	1 (3NS) 1 (dup)	NS	NS	1	4	--	1 (3NS)
pH (Q)	1	4	NS	NS	1	1 (3NS)	1	1 (3NS)
SC (Q)	1	4	NS	NS	1	1 (3NS)	1	1 (3NS)
Phenols	1	2	NS	NS	1	1	--	1
Total Metals	NA	2	NS	NS	NA	1	NA	1
Dissolved Metals	NA	2	NS	NS	NA	1	NA	1
Diss. Metals (Fe, Mn, Na)	1	NA	NS	NS	1	NA	--	NA
SO4, Cl, F, Turb.	NA	2	NS	NS	NA	1	NA	1
NO3, TKN, PO4	NA	2	NS	NS	NA	1	NA	1
Inorganics: SO4, Cl	1	NA	NS	NS	1	NA	--	NA

Abbreviations: TOX = total organic halogens; TOC = total organic carbon; SC = specific conductance
SO4 = sulfate; Cl = chloride; F = fluoride; Turb. = Turbidity
Fe = Iron; Mn = Manganese; Na = Sodium
NO3 = nitrate; TKN = total kjeldahl nitrogen; PO4 = phosphate

Notes: br = broken; dup = duplicate; NS = Not sampled due to insufficient volume
NA = not analyzed; Q = Quadruplicate analyses required
-- = Not sampled by facility as a result of consultant's departure.

QA/QC Sample Summary: Facility - equipment blank
Jacobs - equipment blank
trip blank
duplicate sample (MW-13)

TABLE 4
SAMPLE CONTAINERS AND PRESERVATIVES
(as documented in the field)

ANALYTE	COLLIS Container	COLLIS Preservative	JACOBS Container	JACOBS Preservative
Dissolved Metals (Fe, Mn, Na)	250 ml polyethylene	Filtered**, HNO3, iced	NA	NA
Total Metals	NA	NA	1-L plastic cubitainer	HNO3, iced
Dissolved Metals	NA	NA	4 oz. polyethylene	filtered, HNO3, iced
Total Organic Halogens (TOX)	1-L amber glass*	iced**, no headspace	250 ml amber glass	iced, no headspace
Total Organic Carbon (TOC))	250 ml polyurethane**	filtered*,**; H2SO4**, iced	4 oz. polyethylene**	HCl, iced, no headspace
Phenols	500 ml glass	iced, H2SO4	1-L plastic cubitainer	CuSO4/H2SO4, iced
Indicators: SO4, Cl	1-L polyethylene	filtered*,**; iced	NA	NA
Nitrate, TKN, Phosphorus	NA	NA	1-L plastic cubitainer	H2SO4, iced
Chloride, Fluoride, Turbidity, Sulfate	NA	NA	1-L plastic cubitainer	iced

* conflicts with facility's Sampling and Analysis Plan prepared by Warzyn.

** conflicts with procedures set forth in the RCRA Technical Enforcement Guidance Document.

NA = Not Analyzed

SO4 = Sulfate; Cl = Chloride, TKN = Total Kjeldahl Nitrogen; Fe = Iron; Mn = Manganese; Na = Sodium

HNO3 = Nitric Acid; CuSO4 = Copper sulfate; H2SO4 = Sulfuric Acid

ATTACHMENT 7

COLLIS DRAFT SAMPLING AND ANALYSIS PLAN

ATTACHMENT 7

COLLIS DRAFT SAMPLING AND ANALYSIS PLAN

WARZYN

Engineers & Scientists
Environmental Services
Waste Management
Water Resources
Site Development
Special Structures
Geotechnical Analysis

January 27, 1988
60123

Mr. Harry Gabbert
U.S. EPA Region VII
RCRA Section
726 Minnesota Avenue
Kansas City, Kansas 66101

Dear Mr. Gabbert:

Pursuant to your request, please find transmitted one copy of the "Sampling and Analysis Plan" January 1988 for Collis, Inc. in Clinton, Iowa. If you should have any questions, please contact me at 312/773-8484.

Sincerely,

WARZYN ENGINEERING INC.

J D Adams/LSS

Joseph D. Adams Jr., P.E.
General Manager - Chicago

Enclosure

123L04LS

cc: Mr. Robert A. Bell
Mr. Michael Dolan
Mr. Thomas Styczen

Warzyn Engineering Inc.
Hamilton Lakes
One Pierce Place
Suite [illegible]
Itasca Illinois 60143-26[illegible]
(312) 773-84[illegible]

SAMPLING AND ANALYSIS PLAN

GROUNDWATER MONITORING PLAN FOR
SITE CLOSURE FOR METAL FINISHING IMPOUNDMENT

COLLIS, INC.
CLINTON, IOWA

REVISION: DRAFT

DATE: JANUARY 1988

WARZYN

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WARZYN

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WARZYN

1.0 INTRODUCTION

1.1 OBJECTIVES

The Plan documents the procedures which the sampling team personnel will follow. This Sampling and Analysis Plan (SAP) describes the field activities involved in sample collection during performance of the groundwater monitoring plan for site closure of the four (4) metal finishing impoundments at the Collis, Inc. facility in Clinton, Iowa. The Plan was designed in accordance with the applicable regulations (40 CFR 265 Subpart F). The groundwater monitoring program will be performed to gather and assess information needed to accomplish the following general objectives:

- o Assess the impact of the impoundment areas on the groundwater system,
- o Identify potential pathways of migration of potential contaminants from the impoundment area,
- o Provide data to conduct a detailed evaluation for further remediation if necessary, and
- o Provide further recommendations for groundwater monitoring at the site.

Available data and information concerning the groundwater quality in the impoundment area are insufficient for the purpose of a site closure. Several of the existing wells are too far from the impoundment area. Wells were not constructed properly or there are inadequate records concerning well construction, so interpretation of monitoring results would be questionable. In addition, existing sampling results indicate the possibility of surface contamination or improper well construction.

An effective groundwater monitoring plan will be implemented and consist of the following:

- o Installing monitoring wells and collecting groundwater samples for analysis, and
- o Establishing background groundwater quality data.

1.2 SAMPLING TEAM MEMBER RESPONSIBILITIES

Field sampling will be performed by Warzyn Engineering Inc. (Warzyn). Responsibilities of the sampling team members are described below.

1.2.1 Field Coordinator

The Field Coordinator (FC) will be responsible for the sampling efforts; will assure the availability and maintenance of all sampling equipment; and materials and will provide for shipping and packing materials. The FC will be responsible for the completion of all chain-of-custody and sample traffic forms; for the proper handling and shipping of the samples collected; and for the accurate completion of field log books. The FC will also be responsible for maintaining communications with on-site and off-site personnel.

The FC is also responsible for daily supervision and documentation of all safety, decontamination, environmental monitoring, and field medical monitoring activities. The FC is responsible for assuring that all field personnel comply with the provisions of the Site Health and Safety Plan and has the authority to stop site work in the event of safety violations. The FC is responsible for designating and marking restricted areas during various site activities and for redesignating these areas as unrestricted when it is appropriate to do so.

1.2.2 Sampling Team Members

The Sampling Team Members (STM) will perform field measurements, complete sampling logs, collect samples, transfer them for shipping, decontaminate sampling equipment, and assist with shipping and packaging as directed by the FC.

2.0 GENERAL SAMPLING INFORMATION

2.1 SCOPE

The groundwater monitoring program will involve the collection and analysis of representative groundwater samples. The groundwater sampling will be conducted on a monthly basis for four months and again during the sixth month. Quarterly sampling will then be conducted to more accurately assess the groundwater quality which will represent seasonal changes (e.g. spring, winter) until the end of the first year.

Compliance monitoring will be initiated one month after well completion. Sampling will be conducted on a quarterly basis for the first year, and then, assuming compliance, it will be continued semi-annually for at least two (2) years following well completion. Monitoring will be discontinued after clean closure has been demonstrated.

Table 1 presents a summary of the groundwater sampling including monitoring wells to be sampled, parameters to be tested, and the monitoring schedule. Samples will be collected from each of the three proposed monitoring wells and existing well MW13. The samples will be analyzed for the groundwater contamination indicators listed in Table 1 during the first four months and at the sixth, eighth, and eleventh months of the first year. Thereafter, analysis for contamination indicators will be conducted semi-annually. The samples will be analyzed for the groundwater quality indicators (listed in Table 1) during the first and sixth months of the first year and thereafter, once per year.

A data base of background water quality will be established by conducting quadruplicate analyses (i.e. four replicates) from the upgradient monitoring well (MW22) for each of the first four months after well construction. The samples will be analyzed for the groundwater contamination indicators in Table 1. The samples collected from all wells during the sixth month will be used to test for statistically significant variation from the background water quality data base. Quadruplicate analyses of the contamination indicators will be performed on these samples.

2.2 SAMPLE SHIPMENT

Following sample collections, the STM will help the FC prepare documentation and package the bottles for shipment. Bottles will be labeled with all required information and this information recorded on field recording sheets.

Sample bottles will be placed in coolers for storage and shipment as indicated in Table 2. Ice will be sealed in plastic bags to prevent leakage. The bottles will be cushioned using plastic, foam or other similar packing material. Samples will be shipped to the Warzyn Analytical Laboratory in Madison, Wisconsin; via overnight courier.

2.3 QUALITY CONTROL REQUIREMENTS

The sampling activities will include the collection of field blanks for purposes of quality control. One field blank will be prepared for each sample type and container size. One field blank will be prepared per group of 10 or fewer samples of water collected per sampling activity. The field blank sample will be prepared using deionized water. The field blank water will be routed through the bailer which was used for sampling the wells.

3.0 SAMPLING LOCATIONS AND PROCEDURES

3.1 GROUNDWATER MONITORING WELLS

3.1.1 Monitoring Well Construction

Three (3) proposed monitoring wells and one (1) existing monitoring well will be sampled to provide data concerning contaminant sources, potential contamination pathways and variation of chemical concentration with depth. The locations of these wells are shown on Figure 1.

The monitoring system will consist of four (4) monitoring wells, one (1) well located upgradient (northeast) of the former impoundment area, and three (3) located downgradient (southwest) of the impoundment area. Existing monitoring well MW13 will be supplemented by constructing three (3) additional monitoring wells, MW20, MW21, and MW22. Well MW22 will be constructed approximately 150 feet southeast of the surface impoundment area and will provide upgradient groundwater data. Two (2) new wells, MW20 and MW21, will supplement existing well MW13 to provide downgradient groundwater data. MW20 and MW21 will be installed within 10 feet of the excavation area.

Soil borings for each monitoring well will be advanced by a drill rig using 6.25-inch inside diameter hollow stem augers. Each boring will be continuously sampled by split-barrel sampler and a field log will be kept by a qualified geologist or geological engineer.

All new monitoring wells will be constructed with 2-inch inside diameter schedule 40 PVC well casing and flush threaded 0.010 slotted PVC screen. The monitoring well screens will be placed to intersect the water table in the unconsolidated deposits which overlie the bedrock at the site. Clean washed silica sand will be placed in the annular space around the screen. To prepare an effective sand pack, dry sand will be dropped, several handfuls at a time, down the space between the hollow stem auger and well casing. The sand pack will extend 2 feet above the top of the screen. A 2-foot seal of bentonite pellets will be placed on top of the sand pack, also by dropping small quantities to avoid bridging above the zone of interest. The pellets will be allowed to hydrate, either by formation water, or by addition of potable water. The remaining annulus will then be backfilled with a 10 percent bentonite/cement grout mixture. The grout will be injected from the bottom of the open annulus through a tremie pipe with side openings.

Finally, a locking steel protective casing will be placed over the well. It will be set in a concrete pad, which is finished sloping outward from the casing to allow surface runoff. A detail showing typical monitoring well construction is provided in Figure 2. All drilling tools such as augers, rods, and drill bits will be steam-cleaned between each well. Each well will be developed by bailing until pH and specific conductance have stabilized. Stabilization will be determined by three successive measurements of pH with no greater change than 0.5 pH units and of conductivity with no greater than five percent.

3.1.2 Groundwater Monitoring Well Sampling

Prior to any monitoring well sampling, a static groundwater elevation measurement (depth to water) will be taken. The groundwater elevation measurement will be made on all accessible monitoring wells, and the data will be used to determine hydraulic gradient and to calculate groundwater flow directions. A survey crew will document precise horizontal and vertical locations of each well. Elevations will be tied to U.S. Geological Survey elevations so groundwater elevations can be used to construct water table maps and calculate hydraulic gradients.

Monitoring wells will be purged using a pump or a bailer to remove a volume of water at least three (3) times the casing volume. If the well is pumped dry and exhibits slow-recovery, it will be allowed to recover prior to collecting samples.

Samples will be collected no more than 24 hours following the purging of the monitoring wells. The first water collected will be submitted for the total organics carbon analysis. Specific conductivity, temperature, and pH will be measured in the field at the time of sampling, using portable instruments in accordance with Section 3. Field temperature measurements will be made solely for the purpose of calculating specific conductance at 25°C.

Groundwater samples will be collected for the parameters and at the frequency described in Section 2.1 and listed in Table 1. Two field duplicate and two field blank samples will be collected according to the guidelines presented in Section 2.3. One field duplicate and field blank samples will be collected from a new shallow monitoring well, and a second set of duplicates and blank samples will be collected from an existing monitoring well. Duplicate samples will be obtained by first filling one set of sample bottles for the parameters to be tested and then filling a second (identical) set of sample bottles from the same well. The blank samples will be prepared using deionized water stored in polyethylene containers.

The sample bottles and sample preservation required for this activity are listed in Table 2. Samples collected for analysis of dissolved metals (iron, manganese, and sulfate) will be filtered in the field using 0.45-micron filter apparatus and a hand-powered or electric-powered vacuum pump. Samples will be preserved after filtering. The field blank sample for dissolved metals will be routed through the filtering apparatus. Monitoring well samples will be shipped daily to the Warzyn Analytical Laboratory in Madison, Wisconsin. All monitoring well samples will be tested for parameters as shown on Table 1.

3.2 FIELD TESTS FOR pH, TEMPERATURE AND CONDUCTIVITY

Specific conductivity, temperature and pH will be measured in the field using portable instruments at the time of sampling each monitoring well. The conductivity meter will be zeroed according to procedures specified for the instrument prior to recording measurements for the day. Buffer solutions bracketing the reading will be used to calibrate the pH meter prior to and after use each day. A small volume of sample will be taken from the source and poured into polyethylene or glass containers and the instrument probes placed into the water. Following readings, the water samples will be discarded and the instrument probes decontaminated. Temperature measurements will be made solely for the purpose of calculating specific conductance at 25°C. Measurements, including calibration data, will be recorded in the field notebook and/or the field recording sheets. The field measurement data will be used to trace and identify suspect contamination.

4.0 DECONTAMINATION PROCEDURES

Procedures to decontaminate equipment and personnel are summarized below.

4.1 PERSONNEL DECONTAMINATION

Personnel decontamination will be conducted before leaving a work area and will include (but not be limited to) the following procedures:

1. Remove disposable coveralls, booties, and outer gloves and place in plastic bags;
2. Wash boots in soap and water (alconox or equivalent) if visually contaminated or bootie had torn during work;
3. Remove hard hat and store in appropriate place; and
4. Remove disposable inner gloves (if used) and place in plastic bag.

Personnel will be careful to wash hands and face before eating.

4.2 EQUIPMENT DECONTAMINATION

All sampling equipment (including bailers) will be decontaminated prior to use, and all reusable non-dedicated equipment (scoops, buckets, split spoons) will be decontaminated between samples and before removal from the site. The procedure is as follows:

- o Soap (alconox or equivalent) and water wash;
- o Potable water rinse; and
- o Deionized water rinse at least twice.

4.3 GENERATED WASTES

All disposable protective clothing and disposable sampling equipment will be placed into plastic bags and disposed of at the direction of Collis, Inc. All liquids such as development, purge, and decontamination water will be drained onto the ground at the site. These materials are not considered as hazardous by Warzyn and will require no special handling.

5.0 DOCUMENTATION

5.1 FIELD LOG BOOKS

Field log books and Warzyn field recording sheets will be used to record data. Entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Bound field survey books will be used to record field logs. Each log book will be identified by the project number.

The title page of each notebook will contain:

- Person or organization to whom the book is assigned,
- Book number,
- Project name and number,
- Start date, and
- End date.

Entries into the log book will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site and the purpose of their visit will be recorded in the field log book.

Measurements made and samples collected will be recorded in the books and recording sheets and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Wherever a sample is collected or a measurement is made, a description of the location of the station shall be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the procedures documented in the SAP (Sections 2 and 3). The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, and volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Duplicates, which will receive a separate sample identification number, will be noted under sample description.

5.2 SAMPLE IDENTIFICATION DESIGNATION

A sample numbering system will be used to identify each sample, including duplicates and blanks. Each sample identifier will have three components: a project identifier; a sample type and location code; and a numerical code indicating the sampling event. A listing of sample identifications will be maintained in a log book kept by the FC.

5.2.1 Project Identifier

A two-letter designation will be used to identify the sample collection site. For this project, the designation will be CL, which represents Collis.

Each sample collected will be identified by a two-digit alpha code corresponding to the type of sample, followed by the sample location number. The alpha codes are as follows:

- GW - Groundwater sample from monitoring well.
- SS - Soil split spoon sample from soil boring.
- SW - Surface water sample.
- FB - Field Blank

A four-digit numbering system coresponding to the well identification will be used to indicate the sampling location. All other pertinent data related to sampling locations will be kept in the field sampling notebook.

5.2.2 Sampling Event

Samples will have an identifier to indicate sampling event ("01", "02", etc.). Duplicate samples will be identified by "91" for the first sampling event, "92" for the second sampling and so on.

5.2.3 Example of Sample Numbers

An example of a sample number is:

CL-GWMW22-92

Collis Inc. Site - groundwater sample from monitoring well MW22, duplicate sample, second sampling event.

All other pertinent data relating to the sampling event will be included in the sampling notebook.

5.3 PHOTOGRAPHS

Representative photographs may be taken of sampling stations to show surrounding area and used to locate the station. The film roll number may be identified by taking a photograph of an informational sign on the first frame of the roll. This sign would have the job and film roll number written on it so as to identify the pictures contained on the roll.

For example:

Collis, Inc.
Roll Number 1
July 1, 1988

5.4 SAMPLE DOCUMENTATION

All samples will be collected under chain-of-custody procedures and will include the use of chain-of-custody forms, custody seals, and field notebooks or field recording sheets for sample documentation. The latter will include sampling time, location, samplers, pertinent PID readings, weather conditions, and any field modifications of sampling strategy. Standard forms including chain-of-custody record forms, sample labels, and chain-of-custody seals will be maintained throughout the sampling activities.

A copy of the chain-of-custody form to be used is shown in Figure 3. Requirements for these forms include the following:

- Separate forms will be used for each shipping container (steel foam or plastic cooler);
- Carrier service does not need to sign form if custody seals remain intact during shipment; and
- All samples will be listed on a chain-of-custody form.

An example of the chain-of-custody seal to be used for sample shipping is shown in Figure 4. Seal requirements include the following:

- o Two (2) chain-of-custody seals per shipping container will be attached to the cooler lid to provide evidence that samples within have not been disturbed in transit;

- o Seals will be covered with clear tape prior to shipping sample containers; and

- o Chain-of-custody seal numbers will be recorded on chain-of-custody forms.

A copy of the sample label to be used for the samples is shown is Figure 5. Each sample container must have a sample label affixed to it. The label will specify sample date, parameters for analysis, and preservative used.

The documentation accompanying the samples shipped to the laboratory will be sealed in a plastic bag taped to the inside of the cooler lid. The lid of the sample cooler will be securely taped shut prior to shipment. The FC will be responsible for collecting the samples, completing the sample documentation and properly packaging the samples for shipment to the laboratory with the help of the STM. Once in the laboratory's possession, sample custody will be the responsibility of the laboratory sample custodian.

All pertinent information regarding the samples will be recorded in the site log book maintained by the FC and in logs maintained by each sampling crew. The information will include sampling time, location, designation, and samplers. Photoionization detector (PID) readings, weather conditions and field modifications of sampling strategy will also be recorded. Any photographs taken at sampling locations will be noted in the logs with the time, date, and location recorded.

TABLE 1
SUMMARY OF GROUNDWATER SAMPLING
COLLIS, INC.
CLINTON, IOWA

I. MONITORING WELLS TO BE SAMPLED

MONITORING WELLS: MW13 MW20 MW21 MW22

II. PARAMETERS TO BE TESTED

Contamination Indicators

pH (field)
Specific Conductance (field)
Total Organic Carbon
Total Organic Halogen

Quality Indicators

Chloride
Iron
Manganese
Phenols
Sodium
Sulfate

III. MONITORING SCHEDULE

First Year - Month 1

Contamination Indicators, all wells
Quality Indicators, all wells
Depth to Water, all wells

First Year, Months 2, 3 and 4

Contamination Indicators, MW22 only
Depth to Water, all wells

First Year - 6th Month

Contamination Indicators, MW-22
Quality Indicators, all wells
Depth to Water

First Year, Months 8 and 11

Contamination Indicators, all wells
Depth to Water, all wells

Second Year - Semi-Annual Monitoring

Contamination Indicators, all wells
Depth to Water, all wells

Second Year - Annual Monitoring

Quality Indicators, all wells
Depth to Water, all wells

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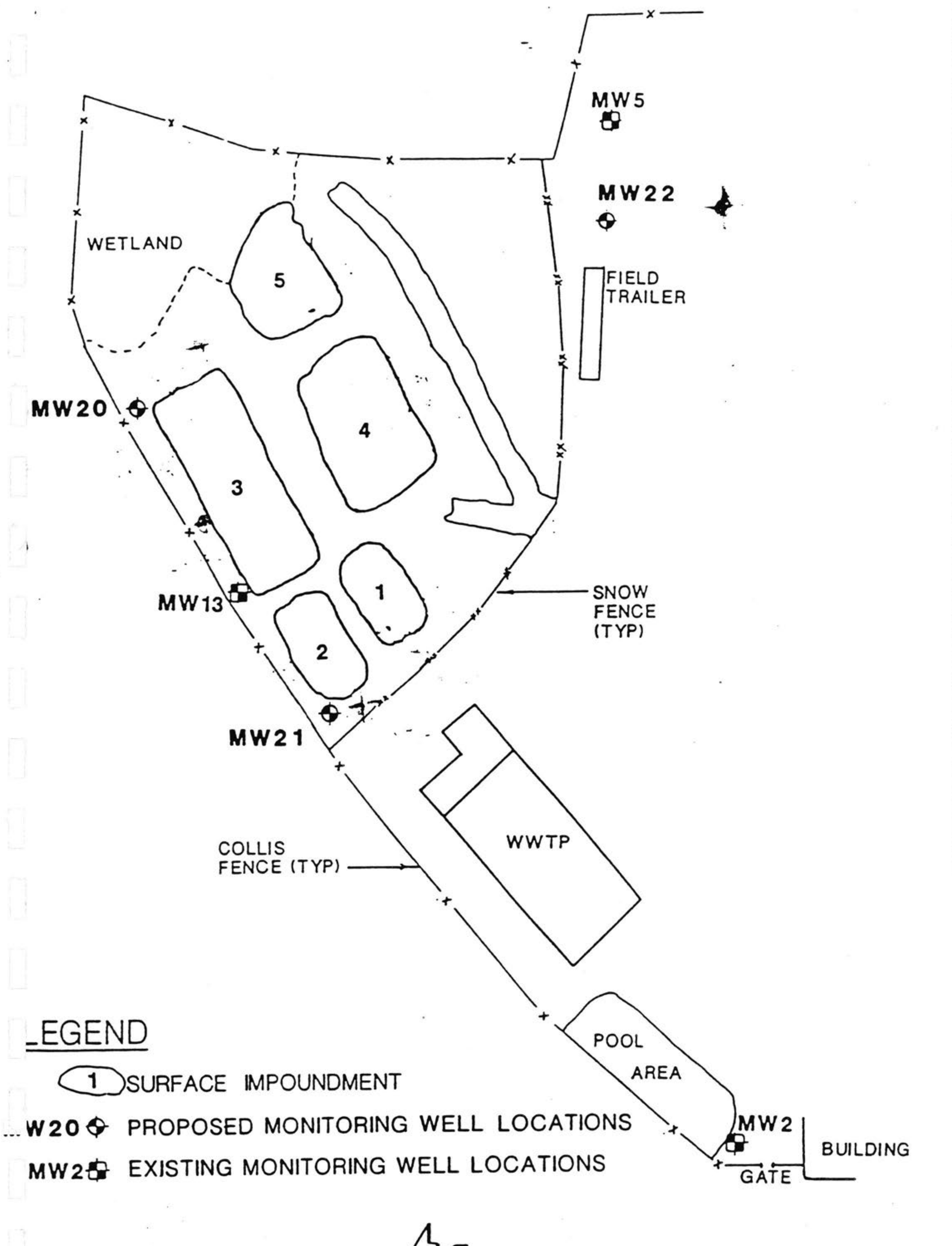
TABLE 2

SAMPLE QUANTITIES, BOTTLES, PRESERVATION AND PACKAGING
REQUIRMENTS FOR WATER SAMPLES
COLLIS, INCORPORATED

ANALYSIS	BOTTLES AND JARS	PRESERVATION	HOLDING TIME	VOLUME OF SAMPLE	SHIPPING	PACKAGING
MONITORING WELL						
Total Organic Carbon (TOC)	One 250-ml high density polyurethane bottle	5 ml/l, 1:1 H_2SO_4 to a pH<2, Iced to 4^oC	28 days	Fill bottle to neck	Overnight Delivery	No. 1 foam liner or vermiculite
Total Organic Halogen (TOX)	One 250-ml glass amber bottles (Teflon-Lined Caps)	Iced to 4^oC	14 days	Fill bottle completely with no head space	Overnight Delivery	No. 1 foam liner or vermiculite
Phenols	One 500 ml. glass bottle (Teflon-Lined Caps)	5 ml/l, 1:1 H_2SO_4 to a pH<4, Iced to 4^oC	28 days	Fill bottle completely with no head space	Overnight Delivery	No. 1 foam liner or vermiculite
Inorganics Metals (iron, manganese, sodium)	One 250-ml high density Polyethylene Bottle	5-ml/L,1:1 HNO_3 to pH <2, Iced to 4^oC.	6 months	Fill to shoulder of bottle	Overnight Delivery	No. 1 foam liner or vermiculite
INDICATOR PARAMETERS						
Alkalinity	One 1-Liter high density Polyethylene Bottle[1]	Iced to 4^oC	14 days	Fill to shoulder of bottle	Overnight Delivery	No. 1 foam liner or vermiculite
Chloride	One 1-Liter high density Polyethylene Bottle[1]	None Required	28 days	Fill to shoulder of bottle	Overnight Delivery	No. 1 foam liner or vermiculite
Sulfate	One 1-Liter high density Polyethylene Bottle[1]	Iced to 4^oC	28 days	Fill to shoulder of bottle	Overnight Delivery	No. 1 foam liner or vermiculite

NOTE

1 - 1 LITER TOTAL NEEDED FOR ALL INDICATORS LISTED



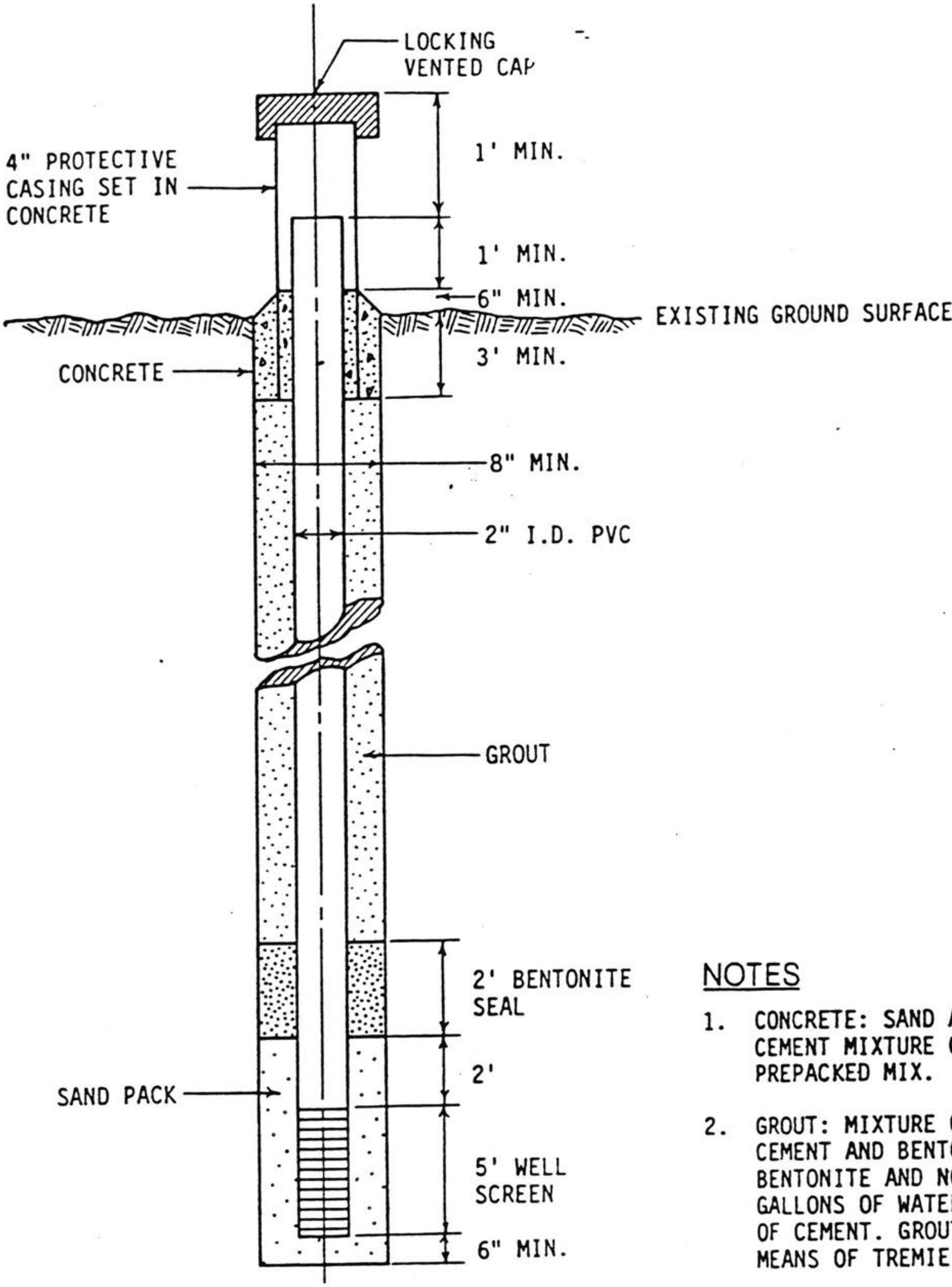
APPROXIMATE SCALE: 1" = 70'

DWN A.L.H. APP'D ... DATE ... 60123-A2

WARZYN ENGINEERING INC

FIGURE 1

MONITORING WELL LOCATIONS
COLLIS, INC.
CLINTON, IOWA



NOTES

1. CONCRETE: SAND AND PORTLAND CEMENT MIXTURE OR SAKRETE PREPACKED MIX.

2. GROUT: MIXTURE OF PORTLAND CEMENT AND BENTONITE USING 10% BENTONITE AND NO MORE THAN 7 GALLONS OF WATER PER BAG OF CEMENT. GROUT PLACED BY MEANS OF TREMIE GROUTING.

3. SAND PACK: CLEAN WASHED FLINT SAND

4. WELL SCREEN: 2 INCH I.D., 10 SLOT (0.01) PVC

FIGURE 2

NOT TO SCALE				WARZYN ENGINEERING INC	TYPICAL MONITORING WELL DESIGN
DWN ALH	APP'D	DATE	60123-A1		COLLIS, INC. CLINTON, IOWA

University Research Park
... Dr.
Madison, Wisconsin 53705
(608) 273-0440

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
SAMPLERS: *(Signature)*	

LAB NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS								REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*		Date / Time	

Remarks

Distribution: White — Accompanies Shipment; Yellow — Laboratory File; Pink — Coordinator Field Files

№ 7 0645

WARZYN

№ 1467

CHAIN OF CUSTODY SEAL

WARZYN ENGINEERING INC.
ONE SCIENCE COURT
UNIVERSITY RESEARCH PARK
P.O. BOX 5385
MADISON, WI 53705
(608) 273-0440

FIGURE 4
CHAIN-OF-CUSTODY SEAL

Project # ____________________ **Lab #** __________

Sample Description ______________________________

Date Collected ______________ **By** ______________

Preservative: HNO_3 H_2SO_4 NaOH None Other ____
Filtered Unfiltered

FIGURE 5
SAMPLE LABEL

REVIEW OF SAMPLING & ANALYSIS PLAN
DATED JANUARY 27, 1988
COLLIS, INC.
CLINTON, IOWA

The Sampling and Analysis Plan submitted by Warzyn Engineering on the behalf of Collis, Inc. dated January 27, 1988 was reviewed prior to the CME Groundwater Sampling Inspection by Valda Terauds and Larry Phyfe of Jacobs Engineering for consistency with the RCRA Technical Enforcement Guidance Document (TEGD) and EPA SOP No. FR011A, RCRA Groundwater Sampling Inspection. The checklist for elements of a good sampling plan (EPA SOP No. FR011A) was used as a guidance. Comments concerning the sampling plan are listed below.

1. The equipment used for determining static water elevations was not specified.

2. Evacuation procedures:

   a. No calculations were provided to demonstrate how the facility estimates the amount of water which should be purged from the well prior to sampling.

   b. The sampling plan states that either a pump or a bailer will be used to purge the well; the position of the pump intake during well evacuation was not specified.

   c. Liquids purged from the well are not collected, managed, or disposed of in a manner consistent with the TEGD. Purged liquids should be containerized and disposed of following receipt of analyses. An onsite wastewater treatment plant could be used as the disposal mechanisms for the evacuated groundwater.

   d. The elapsed time between well evacuation and sampling should be specified according to the anticipated productivity of the formation. For a productive formation, samples should be collected upon evacuation; for a low-yield well, samples should be obtained when recovery can provide adequate sample volume.

3. Sampling Procedure:

   a. Sampling equipment was not specified.

   b. Sample order was not specified other than that samples for organics (TOX and TOC) will be obtained first, followed by field measurements for pH, Temperature, and Specific Conductance. It is indicated that the sample for dissolved metals (Iron, Manganese, and Sodium) will be field filtered using a 0.45 micron filter with a vacuum pump. The field blank will also be field filtered.

4. Parameters to be Sampled:

   a. Container caps are discussed for TOX and phenols only; specifications for container caps for other parameters were not provided.

   b. TOC preservation technique is not consistent with the EPA SOP. The preservative specified in the guidance is hydrochloric acid, not sulfuric acid.

   c. Laboratory analytical methods are not specified in the plan.

5. Chain of custody procedures are not discussed although an understanding of the process is apparent.

6. Sample shipping was adequately addressed.

7. Appendix III parameter sampling and analysis was not included in the RCRA post-closure monitoring program (violates 40 CFR Part 265, Subpart F, 265.92 (b)(1)).

ATTACHMENT 8

COLLIS DETECTION MONITORING WELL ANALYSES

ROUND 1 ANALYTICAL DATA

ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CHICAGO, ILLINOIS

PROJECT #: 60123.00
DATE SAMPLED: 03/18/88
CK'D: 8Ut APP'D: KDf
DATE ISSUED: 4-19-88

LAB NO. / SAMPLE DESCRIPTION	22080 CL-GWMW13-01	22081 * CL-GWMW13-91	22082 CL-GWMW20-01
TOTAL ORGANIC CARBON	<1.0	<1.0	41.0
TOTAL ORGANIC HALOGEN	<0.005	<0.005	0.625
PHENOL	0.009	0.010	0.009
IRON	<0.05	<0.05	5.64
MANGANESE	0.11	0.16	0.64
SODIUM	17.7	18.0	528
ALKALINITY	292	302	1290
CHLORIDE	34	35	212
SULFATE	77	78	99
PH (S.U.)	7.27	7.32	7.18
CONDUCTIVITY @25*C (UMHOS/CM)	770	775	2830

RESULTS ARE REPORTED IN MG/L UNLESS OTHERWISE STATED.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

* MW13 Duplicate

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CHICAGO, ILLINOIS

PROJECT #: 60123.00
DATE SAMPLED: 03/18/88
CK'D: BCH APP'D: KOF
DATE ISSUED: 4.18.88

LAB NO. / SAMPLE DESCRIPTION	22083 CL-GWMW20-91 *	22084 CL-GWMW21-01	22086 CL-GWFB1-01 **
TOTAL ORGANIC CARBON	42.5	18.9	<1.0
TOTAL ORGANIC HALOGEN	0.600	0.060	<0.005
PHENOL	0.010	0.014	0.011
IRON	4.93	1.32	<0.05
MANGANESE	0.68	0.52	<0.02
SODIUM	550	169	<1.0
ALKALINITY	1300	967	<5
CHLORIDE	214	224	<1
SULFATE	97	136	<5
PH (S.U.)	7.20	6.94	7.36
CONDUCTIVITY @25°C (UMHOS/CM)	2830	2560	<10

RESULTS ARE REPORTED IN MG/L UNLESS OTHERWISE STATED.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

* MW20 Duplicate

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CHICAGO, ILLINOIS

PROJECT #: 60123.00
DATE SAMPLED: 03/18/88
CK'D: BLA APP'D: KDF
DATE ISSUED: 4-19-88

LAB NO. / SAMPLE DESCRIPTION	22087 ** CL-GWFB2-01	22085 CL-GWMW22-01 (QUADRUPLICATE)			
TOTAL ORGANIC CARBON	<1.0	20.1	20.0	19.9	20.0
TOTAL ORGANIC HALOGEN	<0.005	BROKEN BOTTLE			
PHENOL	0.011	0.010			
IRON	<0.05	0.44			
MANGANESE	<0.02	2.54			
SODIUM	<1.0	81.4			
ALKALINITY	<5	735			
CHLORIDE	<1	151			
SULFATE	<5	385			
PH (S.U.)	7.48	6.56	6.55	6.57	6.55
CONDUCTIVITY @25*C (UMHOS/CM)	<10	2120	2120	2120	2120

RESULTS ARE REPORTED IN MG/L UNLESS OTHERWISE STATED.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

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WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 03/18/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 5-16-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.33	585.07
MW-20	590.07	5.48	584.59
MW-21	588.94	3.87	585.07
MW-22	590.24	4.92	585.32

ROUND 2 ANALYTICAL DATA

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION #: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
CK'D: BLH APP'D: KDF
DATE ISSUED: 5-3-88

LAB NO. / SAMPLE DESCRIPTION	22748 / CL-GWMW22-02	22749 / CL-GWMW22-92 *
TOTAL ORGANIC CARBON		
VALUE 1	94	93
VALUE 2	95	95
VALUE 3	85	100
VALUE 4	95	102
AVERAGE	92	98
TOTAL ORGANIC HALOGEN		
VALUE 1	0.241	0.341
VALUE 2	0.303	0.383
VALUE 3	0.416	0.363
VALUE 4	0.215	0.372
AVERAGE	0.294	0.365

RESULTS ARE REPORTED IN MG/L.

METHOD REFERENCES: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 415.1: TOTAL ORGANIC CARBON

SW846, "TEST METHODS FOR EVALUATING SOLID WASTE", SEPTEMBER, 1986.

METHOD 9020: TOTAL ORGANIC HALOGEN

* MW22 Duplicate

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION #: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
CK'D: BLH APP'D: KDF
DATE ISSUED: 5-3-88

LAB NO.	22750
SAMPLE DESCRIPTION	CL-GWFB01-02 **
TOTAL ORGANIC CARBON	<1.0
TOTAL ORGANIC HALOGEN	0.056

RESULTS ARE REPORTED IN MG/L.

METHOD REFERENCES: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 415.1: TOTAL ORGANIC CARBON

SW846, "TEST METHODS FOR EVALUATING SOLID WASTE", SEPTEMBER, 1986.

METHOD 9020: TOTAL ORGANIC HALOGEN

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
CK'D: CAW APP'D: KDF
DATE ISSUED: 7-15-88 DJD

LAB NO. / SAMPLE DESCRIPTION	22748 / CL-GWMW22-02	22749 / CL-GWMW22-92
PH (S.U.)		
VALUE 1	7.00	7.16
VALUE 2	7.04	7.33
VALUE 3	7.08	7.37
VALUE 4	7.18	7.41
AVERAGE	7.08	7.32
CONDUCTIVITY @ 25*C (UMHOS/CM)		
VALUE 1	2630	2640
VALUE 2	2620	2660
VALUE 3	2630	2680
VALUE 4	2640	2690
AVERAGE	2630	2670

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
CK'D: CAW APP'D: KDF
DATE ISSUED: 7-15-88 DJD

LAB NO.	22750
SAMPLE DESCRIPTION	CL-GWFB01-02
PH (S.U.)	8.13
CONDUCTIVITY @25*C (UMHOS/CM)	<10

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY

WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 04/13/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 5-16-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.30	585.10
MW-20	590.07	5.45	584.62
MW-21	588.94	3.86	585.08
MW-22	590.24	4.90	585.34

ROUND 3 ANALYTICAL DATA

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
CK'D: CAW APP'D: KDS
DATE ISSUED: 6-22-88 BJD

LAB NO. / SAMPLE DESCRIPTION	23825 CL-GWMW22-03	23826 CL-GWMW22-93 *	23834 CL-GWFB01-03 **
PH (S.U.)			
VALUE 1	6.79	6.94	7.67
VALUE 2	6.93	7.04	----
VALUE 3	6.97	7.09	----
VALUE 4	7.01	7.08	----
AVERAGE	6.93	7.04	----
CONDUCTIVITY @25*C (UMHOS/CM)			
VALUE 1	2640	2640	<10
VALUE 2	2650	2640	----
VALUE 3	2660	2640	----
VALUE 4	2670	2650	----
AVERAGE	2660	2640	----

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY

* MW22 Duplicate

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
CK'D: OAW APP'D: KDC
DATE ISSUED: 6-22-88
DJD

LAB NO. SAMPLE DESCRIPTION	23825 CL-GWMW22-03	23826 CL-GWMW22-93 *	23834 CL-GWFB01-03 **
TOTAL ORGANIC CARBON (MG/L)			
VALUE 1	88.0	89.0	----
VALUE 2	104	100	----
VALUE 3	101	106	----
VALUE 4	105	86.0	----
AVERAGE	99.5	95.2	----
TOTAL ORGANIC HALOGEN (MG/L)			
VALUE 1	0.075	----	----
VALUE 2	0.146	----	----
VALUE 3	0.374	----	----
VALUE 4	0.114	----	----
AVERAGE	0.177	----	----

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 415.1: TOTAL ORGANIC CARBON

SW846, "TEST METHODS FOR EVALUATING SOLID WASTE", SEPTEMBER, 1986.

METHOD 9020: TOTAL ORGANIC HALOGEN

* MW22 Duplicate

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WARZYN

WARZYN ENGINEERING INC. • ONE SCIENCE COURT • UNIVERSITY RESEARCH PARK • P.O. BOX 5385 • MADISON, WISCONSIN 53705 • (608) 273-0440

ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
CK'D: CAW APP'D: XDF
DATE ISSUED: 6-22-88
DJD

LAB NO. / SAMPLE DESCRIPTION	23827 CL-SW01-03	23828 CL-SW02-03	23829 CL-SW03-03	23830 CL-SW04-03
PH (S.U.)	7.52	7.57	7.52	7.63
CONDUCTIVITY @25*C (UMHOS/CM)	530	515	505	520
CHROMIUM	<0.02	<0.02	<0.02	<0.02
CADMIUM	<0.01	<0.01	<0.01	<0.01
NICKEL	0.02	0.02	0.03	0.02
CYANIDE	0.066	0.058	0.045	0.066

RESULTS ARE REPORTED IN MG/L UNLESS OTHERWISE STATED.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY
METHOD 200.7: CHROMIUM, CADMIUM, NICKEL
METHOD 335.2: CYANIDE

SW-01 was upstream of the ponds

SW-02,03,04 were adjacent to the ponds

SW-05 was downstream of the ponds

WARZYN

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
CK'D: CAW APP'D: KDF
DATE ISSUED: 6-22-88
DJD

LAB NO. SAMPLE DESCRIPTION	23831 CL-SW05-03	23832 CL-SW03-93 *	23833 CL-SWFB01-03 **
PH (S.U.)	7.65	7.57	6.10
CONDUCTIVITY @25*C (UMHOS/CM)	540	500	<10
CHROMIUM	<0.02	<0.02	<0.02
CADMIUM	<0.01	<0.01	<0.01
NICKEL	0.02	0.03	0.03
CYANIDE	0.052	0.064	<0.005

RESULTS ARE REPORTED IN MG/L UNLESS OTHERWISE STATED.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY
METHOD 200.7: CHROMIUM, CADMIUM, NICKEL
METHOD 335.2: CYANIDE

* SW03 Duplicate

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WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 05/12/88
SAMPLED BY: TM
CK'D: LSS APP'D: DJD
DATE ISSUED: 7-14-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	6.62	584.78
MW-20	590.07	5.80	584.27
MW-21	588.94	4.33	584.61
MW-22	590.24	5.39	584.85

ROUND 4 ANALYTICAL DATA

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ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 06/09/88
CK'D: CAW APP'D: KDF
DATE ISSUED: 6-30-88

LAB NO. / SAMPLE DESCRIPTION	24871 GWM22-04	24872 GWM22-94 *	24873 FB02-04 **
TOTAL ORGANIC CARBON			
VALUE 1	66.0	83.0	<1.0
VALUE 2	88.0	--	--
VALUE 3	72.0	--	--
VALUE 4	83.0	--	--
AVERAGE	77.2	--	--
TOTAL ORGANIC HALOGEN			
VALUE 1	0.075	--	--
VALUE 2	0.146	--	--
VALUE 3	0.374	--	--
VALUE 4	0.114	--	--
AVERAGE	0.177	--	--

RESULTS ARE REPORTED IN MG/L.

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANAYLSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 415.1: TOC

SW-846, "TEST METHODS FOR EVALUTING SOLID WASTES" SEPTEMBER, 1986.

METHOD 9020: TOX

* M22 Duplicate

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WARZYN

WARZYN ENGINEERING INC. • ONE SCIENCE COURT • UNIVERSITY RESEARCH PARK • P.O. BOX 5385 • MADISON, WISCONSIN 53705 • (608) 273-0440

ANALYTICAL LABORATORY RESULTS
WI LAB CERTIFICATION ID#: 113138300

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 06/09/88
CK'D: CAW APP'D: KOF
DATE ISSUED: 6-30-88

LAB NO. / SAMPLE DESCRIPTION	24871 GWM22-04	24872 GWM22-94 *	24873 FB02-04 **
PH (S.U.)			
VALUE 1	6.86	6.89	6.71
VALUE 2	6.93	6.92	6.65
VALUE 3	7.09	7.03	6.69
VALUE 4	7.11	7.07	6.73
AVERAGE	7.00	6.98	6.70
CONDUCTIVITY @25*C (UMHOS/CM)			
VALUE 1	2410	2400	<10
VALUE 2	2430	2460	<10
VALUE 3	2450	2450	<10
VALUE 4	2440	2460	<10
AVERAGE	2430	2440	<10

METHOD REFERENCE: EPA-600, "METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES", MARCH, 1983.

METHOD 150.1: PH
METHOD 120.1: CONDUCTIVITY

* M22 Duplicate

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WARZYN

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WATER LEVELS

PROJECT: COLLIS INC.

LOCATION: CLINTON, IOWA

PROJECT #: 60123.00
DATE SAMPLED: 6-9-88
SAMPLED BY: GFP
CK'D: LSS APP'D: DJO
DATE ISSUED: 7-14-88

SAMPLE NO.	CASING ELEV.	DEPTH TO WATER	WATER ELEVATION
MW-13	591.40	7.33	584.07
MW-20	590.07	6.59	583.48
MW-21	588.94	4.96	583.98
MW-22	590.24	6.19	584.05

229A
ACC. 5

JE JACOBS ENGINEERING

RECORD OF PHOTOGRAPHS

Film Type Kodak 35 mm./50 mm lens
ASA Number 200

Roll #1

Collis, Inc.
Project Code 05 B846 00

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
1	8-10-88	8:30	1.8	w/in facility	Drum storage area	Waste oil & cleaning solvent drums
2		8:35	1.8	"	Drum storage area	panorama
3			1.8	"	"	"
4			1.8	"	"	"
5			1.8	"	"	White xytal on floor near drums
6		8:40	11.0	Overcast, 80°F	View to NNW	Waste/trash pickup area
7		8:45	4.0	w/in facility	Choline recycling area	Choline salts & drums
8		8:45	4.0	"	"	choline salts in molds
9		8:45	4.0	"	"	choline neutralization bath
10		8:45	4.0	"	"	sump - chrome wastes
11		9:00	4.0	overcast, 80°F	Above-ground storage tanks; South view	spent acids & cleaning solvents
12		9:05	4.0	"	"	Nitric & hydrochloric acid tanks
13		9:08	4.0	"	"	panorama
14		9:08	4.0	"	"	"
15		9:08	4.0	"	Settling basin near onsite WWTP	"
16		9:08	4.0	"	WWTP	"
17		9:20	5.6	"	Former Impoundments view to NE	Condition of fence around closed impoundments
18		9:20	5.6	"	"	"
19		9:20	5.6	"	"	"
20		9:20	5.6	"	"	"
21		9:25	5.6	"	Settling basin - WWTP	
22						
23						
24						

Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valda Edwards

JE JACOBS ENGINEERING

RECORD OF PHOTOGRAPHS

Film Type Kodak 35 mm / 50 mm lens
ASA Number 200

Roll #1 (contd.)

Collis, Inc.
Project Code 05 B846 00

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
~~1~~ 22	8-10-88	9:35	5.6	Overcast, 80°F	MW-21, NNE view	MW-21, west of impoundments
~~2~~ 23		9:40	5.6	"	Surface impoundments	Panorama to NE
~~3~~ 24		"	"	"	"	"
~~4~~ 25		"	"	"	"	"
~~5~~ 26		"	"	"	"	"
~~6~~ 27		"	"	"	"	"
~~7~~ 28		"	"	"	"	"
~~8~~ 29		9:~~5~~45	5.6	"	MW-13, N. of impound.	Note nylon cord for dedicated PVC bailer
~~9~~ 30		9:47	4.0	"	MW-20, NE of impound	MW-well head sampling
~~10~~ 31		9:48	4.0	"	"	Water level measurement
~~11~~ 32		10:00	4.0	"	View to S & W.	Panorama - Collis facility
~~12~~ 33		"	"	"	"	"
~~13~~ 34		"	"	"	"	"
~~14~~ 35		"	"	"	"	"
~~15~~ 36						
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Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valda Travers

JE

RECORD OF PHOTOGRAPHS

Collis, Inc.

Film Type Kodak 35 mm / 50 mm lens
ASA Number 200

Roll #2

Project Code 05 B 846 00

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
1	8-10-88	10:10	4.0	Overcast, 82°F	MW-22, upgradient	View to S.; MW-22 among pallets
2		10:15	11.0	"	MW-5, upgradient	View to E.; former bckgrd. well
3		10:30	11.0	"	MW-22, upgradient	bailing w/ SS bailer & cable
4		10:50	11.0	"	" "	collecting TOX samples; note top-valve bailer; position of bottle
5		12:40	4.0	w/in Warzyn van	Warzyn van	Millipore filter - MW-13 dissolved metals
6		2:15	8.0	Overcast, 90°	SE lagoon; E. side	red-orange stained water with oil & grease; black silty soils
7		2:20	8.0	"	MW-20; sampling	Note black/gray water and small volume; only 100 ml.
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Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valdis Zeravds

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 1, Roll 1
Location: Drum storage area.
Description: Waste oil and cleaning solvent drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 5, Roll 1

Location: Drum storage area.
Description: White xytal on floor near the drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 6, Roll 1

Location: View to the North, northwest.
Description: Waste/trash pickup area.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 2, 3, 4, Roll 1

Location:
Drum storage area.
Description:
Panorama.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 6, Roll 2

Location: Southeast lagoon; east side.
Description: Red-orange stained water with oil and grease; black silty soils

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 7, Roll 1

Location: Choline recycling area.
Description: Choline salts and drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 8, Roll 1

Location: Choline recycling area.
Description: Choline salts in molds.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 10, Roll 1

Location: Choline recycling area.
Description: Sump - chrome wastes.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

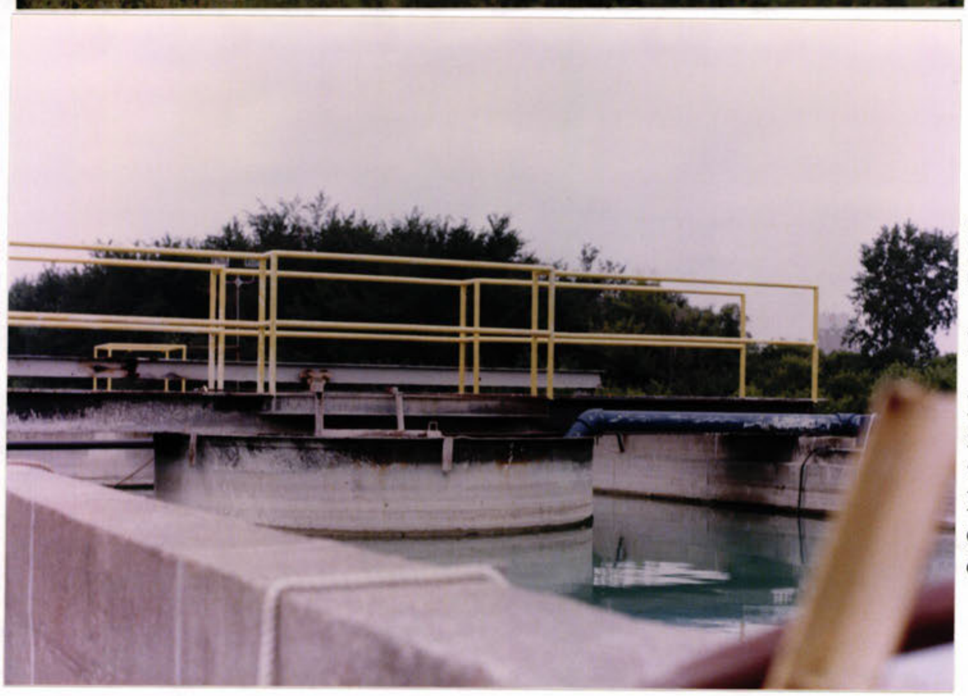
Photo 19, Roll 1

Location: Former impoundments; view to the northeast.
Description: Condition of the fence around the closed impoundments.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 20, Roll 1

Location: Former impoundments; view to the northeast.
Description: Condition of the fence around the closed impoundments.



August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 21, Roll 1

Location: Former impoundments; view to the northeast.
Description: Condition of the fence around the closed impoundments.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 12, Roll 1

Location: Above - ground storage tanks; South view.
Description:
Nitric and hydrochloric acid tanks.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 17, Roll 1

Location: Former impoundments; view to the northeast.
Description:
Condition of the fence around the closed impoundments.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 18, Roll 1

Location: Former impoundments; view to the northeast
Description:
Condition of the fence around the closed impoundments.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 9, Roll 1

Location: Choline recycling area.
Description: Choline neutralization bath.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

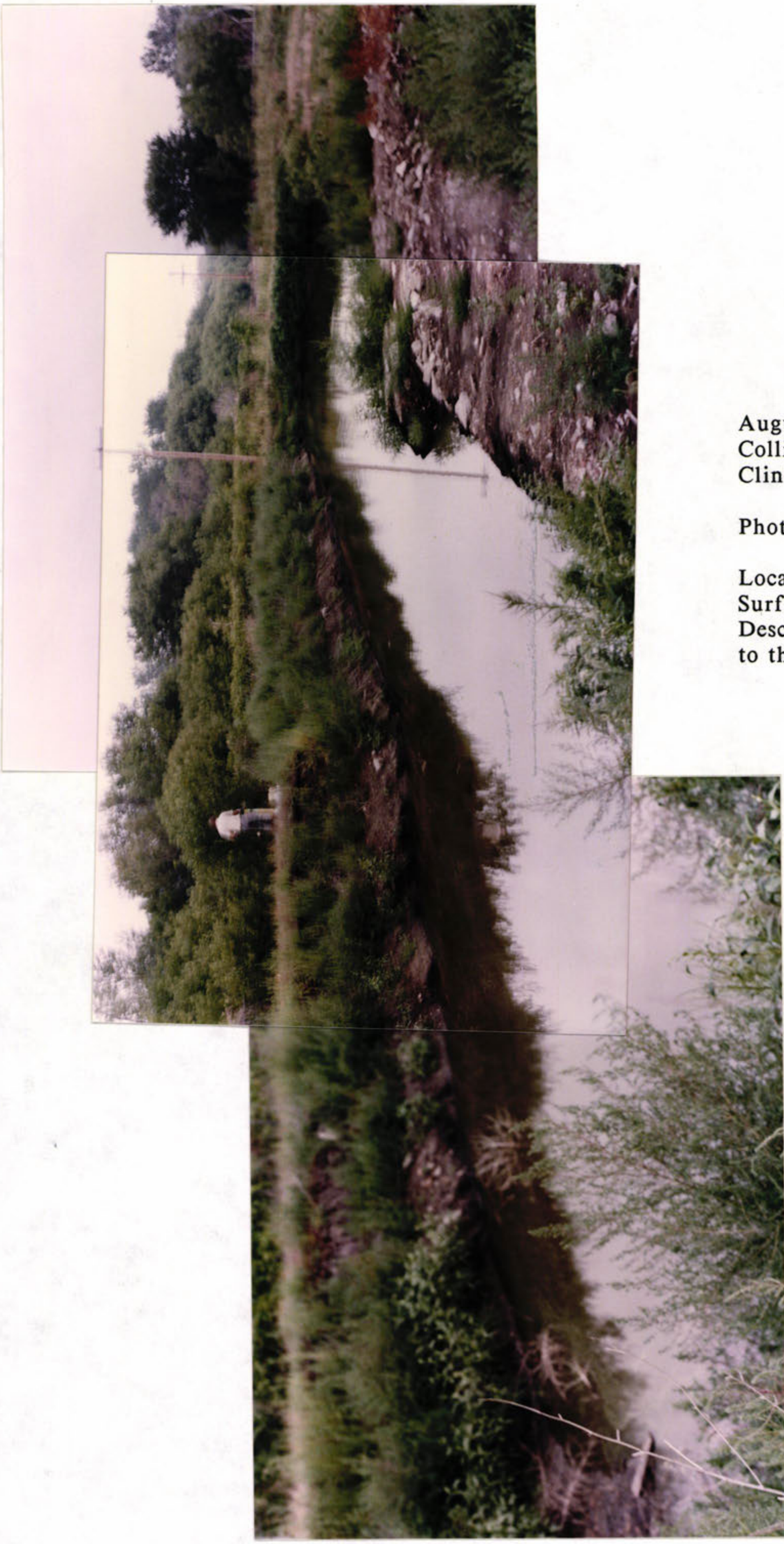
Photo 11, Roll 1

Location: Above - ground storage tanks; South view.
Description: Spent acids and cleaning solvents.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 13, 14, 15, 16, Roll 1

Location:
Settling basin near the onsite Waste water treatment plant.
Description: Panorama.



August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 23, 24, 25, Roll 1

Location:
Surface impoundments.
Description: Panorama
to the northeast.

1988
Collis, Inc. CME
Clinton, Iowa

Photo 26, 27, 28, Roll 1

Location:
Surface impoundments.
Description: Panorama
to the northeast.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 22, Roll 1

Location: MW-21, north, northeast view.
Description: MW-21, west of the impoundments.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 29, Roll 1

Location: MW-13, north of the impoundment.
Description: Note nylon cord for the dedicated PVC bailer.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 30, Roll 1

Location: MW-20,
Northeast of the
impoundment.
Description: Hnu - well
head sampling.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 31, Roll 1

Location: MW-20,
Northeast of the
impoundment.
Description: Water level
measurement.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 32, 33, 34, 35, Roll 1

Location:
View to the south and west.
Description: Panorama of the Collis facility.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 1, Roll 2

Location: MW-22, upgradient.
Description: View to the south; MW-22 among the pallets.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 2, Roll 2

Location: MW-5, upgradient.
Description: View to the east; former background well.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 3, Roll 2

Location: MW-22, upgradient.
Description: Bailing with a stainless steel bailer and cable

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 4, Roll 2

Location: MW-22, upgradient.
Description: Collecting TOX samples; note the top-valve bailer; postion of the bottle.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 5, Roll 2

Location: Warzyn van.
Description: Millipore filter - MW-13 dissolved metals.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 7, Roll 2

Location: MW-20; sampling
Description: Note the black/grey water and small volume; only 100 ml.

JE JACOBS ENGINEERING

RECORD OF PHOTOGRAPHS

Film Type Kodak 35 mm./50 mm lens
ASA Number 200

Roll #1

Collis, Inc.
Project Code 05B84600

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
1	8-10-88	8:30	1.8	w/in facility	Drum storage area	Waste oil & cleaning solvent drums
2		8:35	1.8	"	Drum storage area	panorama
3			1.8	"	"	"
4			1.8	"	"	"
5			1.8	"	"	White xytal on floor near drums
6		8:40	11.0	Overcast, 80° F	View to NNW	Waste/trash pickup area
7		8:45	4.0	w/in facility	Choline recycling area	Choline salts & drums
8		8:45	4.0	"	"	choline salts in molds
9		8:45	4.0	"	"	choline neutralization bath
10		8:45	4.0	"	"	sump - chrome wastes
11		9:00	4.0	overcast, 80°F	Above-ground storage tanks; South view	Spent acids & cleaning solvents
12		9:05	4.0	"	"	Nitric & hydrochloric acid tanks
13		9:08	4.0	"	"	panorama
14		9:08	4.0	"	"	"
15		9:08	4.0	"	Settling basin near onsite WWTP	"
16		9:08	4.0	"	WWTP	"
17		9:20	5.6	"	Former Impoundments view to NE	Condition of fence around closed impoundments
18		9:20	5.6	"	"	"
19		9:20	5.6	"	"	"
20		9:20	5.6	"	"	"
21		9:25	5.6	"	Settling basin - WWTP	
22						
23						
24						

Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valda Terauds

JE JACOBS ENGINEERING

RECORD OF PHOTOGRAPHS

Film Type Kodak 35 mm / 50 mm lens
ASA Number 200

Roll #1 (contd.)

Collis, Inc.
Project Code 05 B846 00

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
~~1~~ 22	8-10-88	9:35	5.6	Overcast, 80°F	MW-21, NNE view	MW-21, west of impoundments
~~2~~ 23		9:40	5.6	"	Surface impoundments	Panorama to NE
~~3~~ 24		"	"	"	"	"
~~4~~ 25		"	"	"	"	"
~~5~~ 26		"	"	"	"	"
~~6~~ 27		"	"	"	"	"
~~7~~ 28		"	"	"	"	"
~~8~~ 29		9:45	5.6	"	MW-13, N. of impound.	Note nylon cord for dedicated PVC bailer
~~9~~ 30		9:47	4.0	"	MW-20, NE of impound	MW-well head sampling
~~10~~ 31		9:48	4.0	"	"	Water level measurement
~~11~~ 32		10:00	4.0	"	View to S & W.	Panorama - Collis facility
~~12~~ 33		"	"	"	"	"
~~13~~ 34		"	"	"	"	"
~~14~~ 35		"	"	"	"	"
~~15~~ 36						
16						
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Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valda Travers

JE

RECORD OF PHOTOGRAPHS

Collis, Inc.

Film Type Kodak 35 mm / 50 mm lens
ASA Number 200

Roll #2

Project Code 05 B 846 00

PHOTO NO.	DATE	TIME	FOCAL LENGTH	WEATHER CONDITIONS	LOCATION	DESCRIPTION OF PHOTOGRAPH
1	8-10-88	10:10	4.0	Overcast, 82°F	MW-22, upgradient	View to S.; MW-22 among pallets
2		10:15	11.0	"	MW-5, upgradient	View to E.; former bckgrd. well
3		10:30	11.0	"	MW-22, upgradient	bailing w/ SS bailer & cable
4		10:50	11.0	"	" "	collecting TOX samples; note top-valve bailer; position of bottle
5		12:40	4.0	w/in Warzyn van	Warzyn van	Millipore filter - MW-13 dissolved metals
6		2:15	8.0	Overcast, 90°	SE lagoon; E. side	red-orange stained water with oil & grease; black silty soils
7		2:20	8.0	"	MW-20; sampling	Note black/gray water and small volume; only 100 ml.
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Notes: (1) Express Time in 24 hour clock notation; (2) Focal Length is of lens used.

Signature of Photographer Valda C Travis

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 1, Roll 1
Location: Drum storage area.
Description: Waste oil and cleaning solvent drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 5, Roll 1

Location: Drum storage area.
Description: White xytal on floor near the drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 6, Roll 1

Location: View to the North, northwest.
Description: Waste/trash pickup area.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 2, 3, 4, Roll 1

Location:
Drum storage area.
Description:
Panorama.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 6, Roll 2

Location: Southeast lagoon; east side.
Description: Red-orange stained water with oil and grease; black silty soils

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 7, Roll 1

Location: Choline recycling area.
Description: Choline salts and drums.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 8, Roll 1

Location: Choline recycling area.
Description: Choline salts in molds.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 10, Roll 1

Location: Choline recycling area.
Description: Sump - chrome wastes.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 9, Roll 1

Location: Choline recycling area.
Description: Choline neutralization bath.

August 10, 1988
Collis, Inc. CME
Clinton, Iowa

Photo 11, Roll 1

Location: Above - ground storage tanks; South view.
Description: Spent acids and cleaning solvents.

August 10, 1988
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Photo 13, 14, 15, 16, Roll 1

Location:
Settling basin near the onsite Waste water treatment plant.
Description: Panorama.

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Clinton, Iowa

Photo 12, Roll 1

Location: Above - ground storage tanks; South view.
Description:
Nitric and hydrochloric acid tanks.

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Photo 17, Roll 1

Location: Former impoundments; view to the northeast.
Description:
Condition of the fence around the closed impoundments.

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Photo 18, Roll 1

Location: Former impoundments; view to the northeast
Description:
Condition of the fence around the closed impoundments.

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Photo 19, Roll 1

Location: Former impoundments; view to the northeast.
Description:
Condition of the fence around the closed impoundments.

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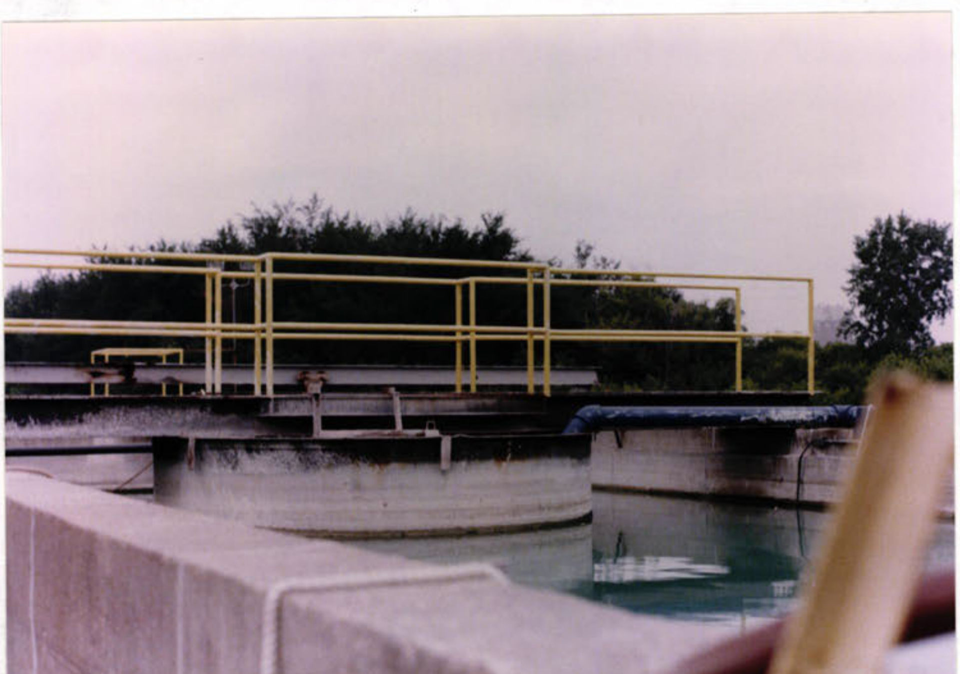
Collis, Inc. CME
Clinton, Iowa

Photo 20, Roll 1

Location: Former impoundments; view to the northeast.
Description:
Condition of the fence around the closed impoundments.



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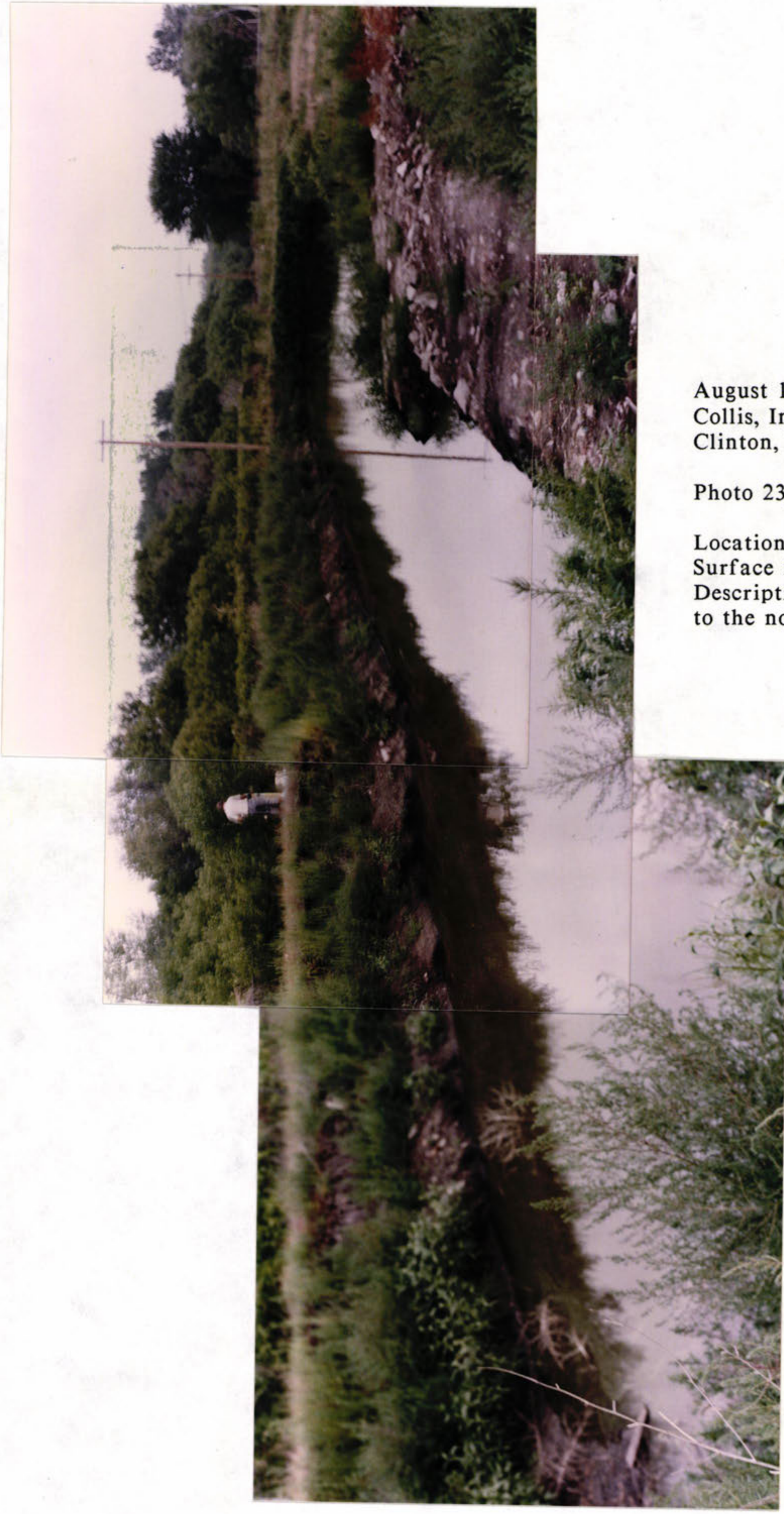
Clinton, Iowa

Photo 21, Roll 1

Location: Former impoundments; view to the northeast.
Description: Condition of the fence around the closed impoundments.



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Clinton, Iowa

Photo 23, 24, 25, Roll 1

Location:
Surface impoundments.
Description: Panorama
to the northeast.

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Photo 26, 27, 28, Roll 1

Location:
Surface impoundments.
Description: Panorama
to the northeast.

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Photo 22, Roll 1

Location: MW-21, north, northeast view.
Description: MW-21, west of the impoundments.

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Photo 29, Roll 1

Location: MW-13, north of the impoundment.
Description: Note nylon cord for the dedicated PVC bailer.

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Photo 30, Roll 1

Location: MW-20,
Northeast of the
impoundment.
Description: Hnu - well
head sampling.

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Photo 31, Roll 1

Location: MW-20,
Northeast of the
impoundment.
Description: Water level
measurement.

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Photo 32, 33, 34, 35, Roll 1

Location:
View to the south and west.
Description: Panorama of the Collis facility.

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Clinton, Iowa

Photo 1, Roll 2

Location: MW-22, upgradient.
Description: View to the south; MW-22 among the pallets.

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Photo 2, Roll 2

Location: MW-5, upgradient.
Description: View to the east; former background well.

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Photo 3, Roll 2

Location: MW-22, upgradient.
Description: Bailing with a stainless steel bailer and cable

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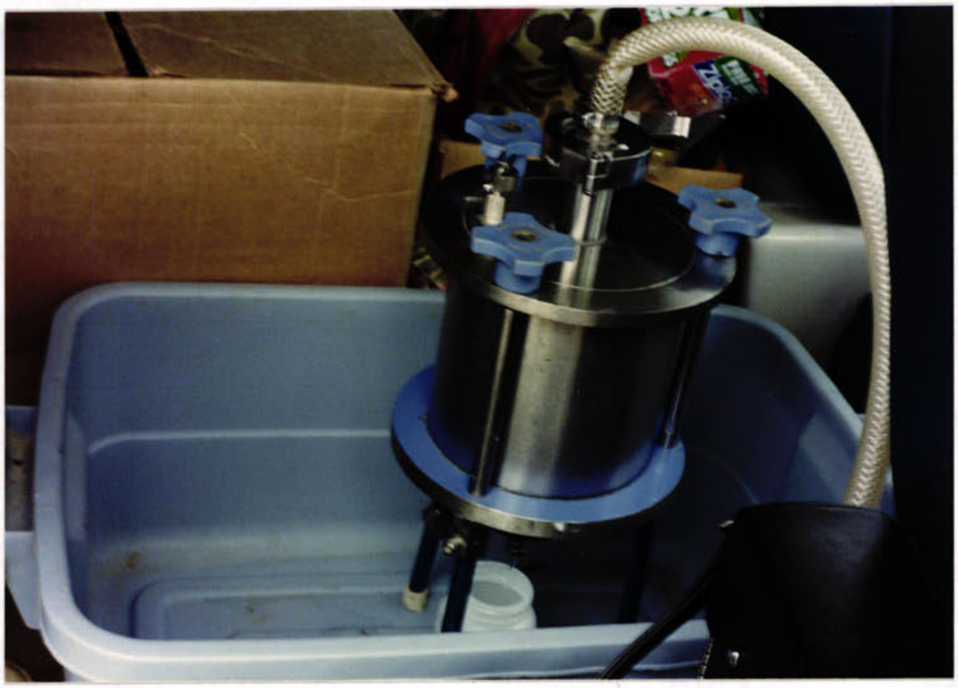
Clinton, Iowa

Photo 4, Roll 2

Location: MW-22, upgradient.
Description: Collecting TOX samples; note the top-valve bailer; postion of the bottle.



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Clinton, Iowa

Photo 5, Roll 2

Location: Warzyn van.
Description: Millipore filter - MW-13 dissolved metals.

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Clinton, Iowa

Photo 7, Roll 2

Location: MW-20; sampling
Description: Note the black/grey water and small volume; only 100 ml.